The Man Wonderful in the House Beautiful

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THE

MAN WONDERFUL

IN THE

HOUSE BEAUTIFUL.

AN ALLEGORY.

TEACHING THE PRINCIPLES OF PHYSIOLOGY AND HYGIENE,

AND

THE EFFECTS OF STIMULANTS AND NARCOTICS.

FOR HOME READING;

ALSO ADAPTED AS

A READER FOR HIGH SCHOOLS AND AS A TEXT-BOOK FOR GRAMMAR, INTERMEDIATE, AND DISTRICT SCHOOLS.

BY

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TO

THE MEMORIES

OF

OUR REVERED MOTHERS,

WHOSE

JUDICIOUS COUNSEL AND SYMPATHETIC ENCOURAGEMENT SUSTAINED WHILE LAYING THE EDUCATIONAL FOUNDATIONS

WHICH MADE ITS WRITING POSSIBLE,

This Book is Dedicated

AS

A TRIBUTE OF FILIAL AFFECTION.

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PART FIRST.—THE HOUSE BEAUTIFUL.

PREFACE.

CONVEYING truth by means of an allegory has been among the most successful of the many methods employed by the ablest teachers. The parables of Christ were adapted not only to the minds of those whom He directly addressed, but also to all ages and classes, and are still as pointed and telling as when first uttered. The object of the Authors in writing this volume has been to present the subjects of Physiology and Hygiene, as well as the effects of Stimulants and Narcotics, upon the human system, in such a pleasing and instructive manner as will be acceptable to all. They hope that the young will study it with such pleasure and advantage that the truths it teaches will be so impressed upon their minds, that they will carry the subjects home with them and create in the minds of their parents a desire to learn the vital truths of their earthly habitations. Parents should be interested in these subjects because of their intimate relation to the health of the present, as well as of future generations. It is all-important that there should be a wide-spread interest in teaching the young what injurious effects arise from the use of narcotics and stimulants.

Science has lately made definite statements, upon

these points, which should be universally known. The sway of Alcohol will be less powerful when the people are fully aware what Alcohol does to the body. A bald statement of facts is not enough to impress the minds of the young with these truths.

The Authors, while endeavoring to shun abstruse and technical phraseology, have not avoided the most difficult subjects, so frequently omitted in elementary works, but have aimed to give a correct and scientific view, in such simple language, accompanied with such correct illustrations, that they hope a better understanding of these subjects will be given than has generally been entertained. Knowing by experience how hard it is to interest children in "dry bones," they have endeavored to clothe them attractively, and to present Science as something else than a series of cold statements, hoping by this means to please the pupils, and, at the same time, to aid the teachers.

Those who have not been able to obtain the needful preliminary training, will find the arrangement of questions to be of great use in the acquirement of facts as well as imparting them to their scholars. If the great truths of Christianity could be taught in allegory, may not less difficult subjects, in the same manner, be made interesting and instructive? Object-lessons, in these later days, have been of great advantage to both teachers and scholars. The instructors who will combine the two methods—object-lessons and allegory—will, without doubt, obtain the best possible results.

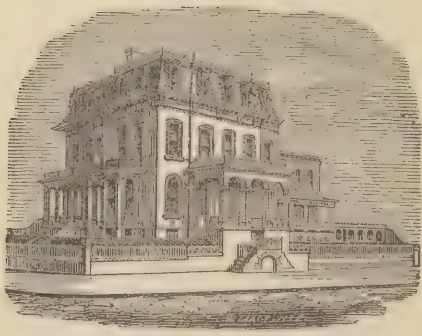
The Authors have received many letters of commendation from teachers of Kindergartens, High-schools, and Grammar-schools who have used, in their

classes, the chapters which appeared in the columns of the *Christian Union.* All speak so highly of their adaptability to such use, and have expressed such a desire to possess them in a permanent form, that great confidence is felt that the book will find a welcome, not only as a scientific reader in High-schools, but also as a text-book in Grammar, Intermediate, and District schools, as well as a book of general interest in the home circle

The Authors have been gathering facts, for this work, for many years, from every reliable authority, and they desire to acknowledge their indebtedness to every source of information which they have used, and especially to Arldt, Jaeger, Rokitansky, Niemeyer, Chrobak, Monti, Duchek, Hyrtle, Billroth, Sattler, Pollitzer, Gruber, Gallazowski, Bowman, Chritchett, Solberg Wells, Tyndall, Huxley, Helmholz, Loomis, Dalton, Flint, Jr., Kirkes, Richardson, Hinton, Carpenter, Mme. Seiler, Sewall, Bartholow, Wood, Elam, and Talmadge. To Professor Foster, Supt. of the Ithaca Schools, they are indebted for valuable suggestions, and to the publishers for most of the illustrations.

ITHACA, N. Y., *Aug.* 6, 1884.

THE WIGWAM.



MODERN IMPROVEMENTS.

PART I.

THE HOUSE BEAUTIFUL

CHAPTER I.

INTRODUCTORY.

[1] In the early history of the human race men lived in caves in the ground, in huts made of earth and logs, or in wigwams made of the skins of animals. But as they became more civilized they enlarged their dwellings, and invented many things to make them more comfortable. [2] It has taken centuries of growth to produce the "modern improvements" of gas, water on each floor, speaking-tubes, stationary tubs, burglar alarms, and telephones.

[3] I am going to tell you of a wonderful house deservedly called "the House Beautiful," which is built by a wise Architect, who has been building such houses ever since the human race existed, and whose great skill and wisdom is proven by the fact that He has never [4] added a room, or made one less, or changed their arrangement. And what is still more remarkable, the very first house of this kind, which was owned by a man named [5] Adam, a gardener, had in it all of the modern improvements, as has each succeeding one. All the rooms are heated by a furnace. There

are water-pipes, gas, burglar alarms, a system of telegraphs and telephones; there are also the stationary tubs in the laundry. I wonder how many of you have guessed what this "House Beautiful" is. [6] Some of you have, I know, and are ready to cry out, "It is our body."

Maybe you have always thought that your body was you. [7] But it is only the house you live in. So, was I not right to say that you each live alone? And perhaps you will be more ready to admit that I was right to call it a house when I tell you of what this wonderful body is composed. [8] The buildings which your bodies inhabit are made of wood, brick, or stone, and are held together by nails or mortar. "But," you say, "that is not the way with our House Beautiful." Let us see. [9] Chemistry is the science which takes things to pieces and finds out of what they are made; not merely breaking them up, as children do their toys sometimes, but decomposing them and learning what things are put together to make even the little pieces. [9] Chemistry tells us that water is made by uniting two gases—oxygen and hydrogen; and that air is made by mixing oxygen and nitrogen. Chemistry takes a piece of glass, and tells us that it is made by uniting silicic acid and potassa in certain proportions. "But how is potassa made?" [10] There are some things which even Chemistry can not find out, and when something is found which Chemistry can not take to pieces, that substance is called an elementary substance, or an element. Elementary means primary. You who have studied about colors have

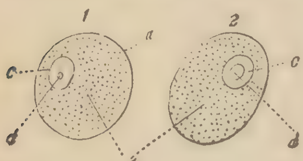
learned that there are three primary colors, red, blue, and yellow, and all other colors are made by uniting these in certain proportions. [11] So, in the formation of the world and all that there is in it, we have about sixty-three elements. In building houses men use iron, plaster, glass, etc., and the Architect of our "House Beautiful" has used the same materials. It is iron that gives our blood its rich red color, which paints such a charming glow on the cheeks and lips, and iron is found in the hair and in the bile and in various parts of the body. Silica, which helps to make glass, is found in the hair and nails; and potassa, the other helper in glass-making, is found in the blood and muscles, and in the fluids of the body. Mortar is made of lime, and our houses would not keep in repair long if we did not furnish them lime for the bones and teeth.

I told you that there are about sixty-three known elementary substances found in nature; but of these only about one-fourth are used in our bodies. [12] They are oxygen, hydrogen, nitrogen, carbon (that is what coal is, you know), sulphur, phosphorus, silicon, chlorine, fluorine, potassium, calcium (that is lime), magnesium, and iron.

These substances are not found in the body in the same state in which we see them as glass, or nails, or sulphur. As you grow in knowledge you will learn in how many wonderful ways all things, animate and inanimate, are working to help each other [13] We can not eat lime or silica, but plants can, and then we eat the plants; or the animals eat them, and we

eat the animals; and so the lime or potassa is made over, so that we can use it in keeping us alive and in repair. So, although it may seem a dry study, it really is of importance for us to know just how and of what we are made, and where we shall find the right things to. feed ourselves, in order that we may grow, and keep strong and well. [14] Everything of which we are made must be obtained from food, and if we do not give the bones enough lime, or the blood enough iron, we get out of repair, which we call being sick.

With this thought in view we begin to study a little more closely into the construction of this wonderful house we live in. [15] We find that every organ is made of cells, or very small bags, filled with something that looks like jelly. This substance has a long name which you may sometimes hear grown people use. [16] It is protoplasm. And you know as much what that means as they do. The cells which contain this jelly-like protoplasm are so small that they can only be seen by a very powerful microscope. Although so small, they are very wonderful, and do what some bigger things can not do. [17] They are all the time dying, and in some strange, wonderful way they have the power to make other cells to take their places. Just as if your mamma died, and in doing so made you a new mamma to take her place, so exactly like her that you could not tell the difference,



STRUCTURE OF THE CELL.

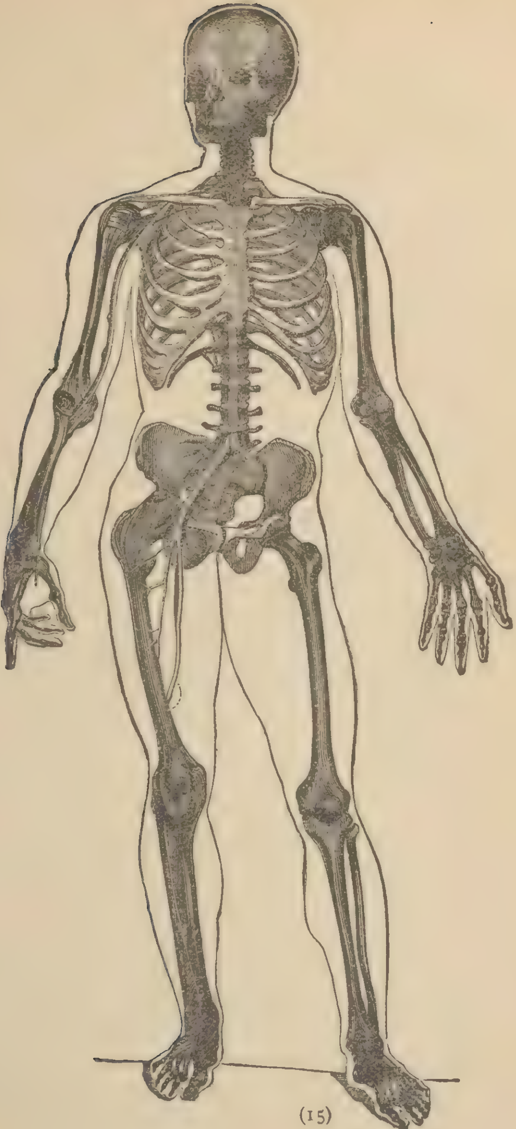
and never knew when the old mamma died, and the new one came. This is going on all through our bodies all the time. Every word we speak, every thought we think, every motion we make, destroys some part of us, and if the new material which comes to take the place of that which is worn out were not just like that which it replaces, in a little while we would be so changed that our dearest friends would not know us. Even our scars are made over from year to year after the same pattern.

[18] When girls and boys are growing, so many entirely new cells have to be added that they change their outward appearance, so that children differ in looks from the men or women they afterward become. Yet enough of the original pattern remains to preserve something of a likeness.

It is strange, but true, that while men have studied everything else with the greatest interest, they have almost forgotten one study which is of great importance to them; [19] the study of these houses which they inhabit; how they are made, destroyed, and kept in repair. [20] Such knowledge learned in early life would save us a world of suffering, and enable us to do far more good than we can do if by ignorance we let these wonderfully beautiful dwellings fall into early decay. People sometimes say that at first the Great Architect made these houses larger and they lasted longer. Be that as it may, it is certain that we can make them last longer if we learn how to take care of them, and how to keep them in repair, by furnishing the cells with the right kind of food in proper quantities.

"Can we keep these little cells alive longer if we hold very still. And would that keep us in better repair?" These little cells are made to live a certain length of time, and if not destroyed by activity before that time, will die then anyway, and, if not removed, become a source of disease. [21] Exercise, while it destroys the tissue which the cells form, also helps to carry them out of the system after they are dead, and thus creates a demand for new material for new cells. [22] This demand we call hunger. It is far better that cells should be destroyed by exercise, and then removed from the body, while food supplies material for new cells, than that they should be left to live as long as they could, and die of old age, and then, because of inactivity of the body, be left to obstruct the system, or to create disease.

So you need not be afraid to work or play, to run and jump, or to help papa or mamma, for that will make you hungry. And the cells will take care of themselves if you give them wholesome food at right times and in right quantities, and let them have a chance to build you over while you take plenty of sweet, refreshing sleep.



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CHAPTER II.

THE FOUNDATION.

[1] THE first thing to be thought of in building a house is its foundation. How strong and broad it shall be made, and how deep it shall be laid in the earth, depend upon the size of the house to be built. A small cottage does not need a foundation as strong as a mill or manufactory. When the great bridge across the Mississippi was built at St. Louis, Mo., the first stones of the foundation were laid one hundred and six feet below the surface of the water. And that wonderful structure, the Brooklyn Bridge, rests on a foundation whose lowest stones are placed seventy-eight feet below the surface of the water. If any one had told the engineers of these massive creations of man's skill that it would not matter what the foundations were if only the superstructure looked pretty, was painted and finely ornamented, they would have shaken their heads and said, "We know better than that. We know that success depends upon our foundation."

Even so our success in life depends largely upon having a good foundation for our "House Beautiful." By this foundation we mean the [2] bones, of which there are about two hundred in the body; and when put together in their places, [3] we call them the skeleton

They are of various shapes, some are short, some are long, and some are irregular. [5] They are made of two kinds of matter, earthy and animal. [6] If you put a bone into the fire the animal matter will burn out and leave the earthy. The shape of the bone will remain, but if you touch it, it will fall to pieces. [7] Muriatic acid will dissolve the earthy matter and leave the animal matter, and then you can tie the bone into a knot without breaking it.

[8] In little children the bones are mostly animal matter, and are therefore soft and will easily bend. [9] They begin to ossify or get bony in little points by the accumulation of calcareous, or limy matter, and these points get bigger until they come together, and at last there is no part of the [10] bone that has not its proper proportion of lime, and then the bones are strong, and the person has "got his growth."

[11] The earthy matter of the bones is principally phosphate of lime, but there is also lime in other forms, besides magnesia and common salt All these things must be obtained from the food we eat. [12] Would it not be funny if, when your papa built a house, he should haul a big pile of bricks and stone and glass, and the house [13] would help itself to whatever was necessary to keep itself in perfect repair? Well, that is just what your "House Beautiful" does, only you have to keep bringing the material every day. How can it keep itself in repair? There are some things which we know are done, although we are not able to explain how. We know that grass grows, but no one knows how it grows. [14] So we

know that every tissue of the body selects its own food, though we can not tell how it knows what is the food it needs. Wise men have studied this wonderful house, and have learned many interesting things about it, and are learning more every day.

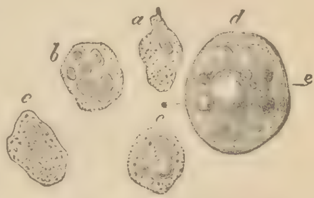
Every bone is covered with a whitish skin or membrane, which is called the *periosteum* (that is a Latin word, and means [15] "around the bone"). [16] This membrane has many blood-vessels running through it, which go into the bone to carry it its food. The *periosteum* fits close to the bone, and its cells, in health, always produce bone.

If the *periosteum* is peeled off and the bone taken out, new bone will be formed, so that we might call it the mother of bone.

If you examine a long bone of an animal, you will see on the side, near the end, a little hole; and in the enlarged ends of the bones several other holes. [17] These are to admit blood-vessels to the inside of the bone. Look carefully, and you will see that the bone is hard and solid on the outside, but if you cut off the end you will see that it is spongy—that is, full of holes—on the inside. These holes are also to carry blood-vessels, and if you examined the bone with a microscope you would see very many others which are so small as not to be visible to the eye without the glass; and all these are canals for blood-vessels; [18] so when you hear people talk of "dry bones" you will know that such bones are dead, for living bones are full of blood, and are eating day and night their breakfasts and dinners of lime.

All this is interesting to learn, but we can make it more than interesting; we can make it practical. That is, we can use our knowledge to our own advantage. What can we learn?[19] Knowing that the bones of babies are mostly animal matter, called *cartilage* or *gristle*, we should be careful not to lift them by their arms, since their soft bones are very easily injured. I have seen a mother who would lift a child by one arm, or raise it to her lap by taking hold of both arms instead of putting her [20] hands on the baby's sides, under its arms. Such a mother did not know how soft her child's bones were, or she would not have been so unkind to it.

[21] In old people the bones are mostly of earthy matter, and therefore will break more easily. [22] We should remember this, and try to guard old folks from getting bad falls. Never play a trick on grandma or grandpa that will result in a fall, for it is a far more serious thing for them to fall than for you. [23] Sometimes, when children do not have the kind of food that furnishes lime for the bones, they have a disease that is called "rickets," and that means nothing more than that their bones are too soft, and need more lime. This is a very practical matter, and we are all interested in learning how we shall give our foundations strength and firmness, so that they shall be able to hold us up and keep us straight, and



CELLS WITH FOREIGN MATTERS.

we shall grow to the full stature of manhood or womanhood.

[24] The best bone-building food is undoubtedly the whole wheat; and by that I mean, not the white flour such as most people use in making bread, but the wheat flour before it is bolted. It would interest you to visit a mill and see how flour is made; then you would understand what I mean by bolting. The Great Architect of the "House Beautiful" made wheat to contain, in nearly the right proportion, everything that is needed to build up the body and keep it in perfect repair. [25] But when men grind the wheat and bolt it they take out of it nearly all the bone-building material.

CHAPTER III.

THE WALLS.

HAVE you never seen a house built with a wooden framework, just as if it were going to be sided on the outside and the spaces between the studding filled in with brick? The frame gave the strength to support the roof and to hold all the different parts of the house together, while the brick walls gave solidity and warmth. We have studied something about our foundations, how they are made largely of lime; [1] but our foundations are also our framework, extending to the roof, inclosing the rooms inside, and supporting the walls without. These walls are of a red color, resembling in tint the beautiful Philadelphia brick, but they are not like bricks in any other respect. [2] Bricks are dead and inert, and when they begin to wear out they crumble away, and if left to themselves will at last fall to pieces and become of no use. [3] The walls of our house are alive, and although they are all the time wearing out, yet they are also all the time repairing themselves; and they do it so quietly and gently that we [4] never know anything about it, unless, as sometimes happens, we do not give the housekeeper the material needed to keep

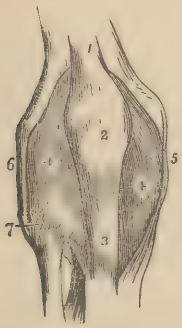
the walls in repair; then they tell us about it by complaining of being tired, when we know they have really done nothing to tire them.


THE FRAMEWORK.

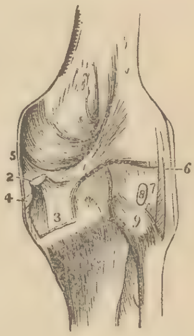
[5] These walls are called muscles, and there are about four hundred of them, or more than that many, but that is an easy number to remember; and you will also remember that there are about twice as many muscles as bones, and that will be enough for you to remember now.

[6] I think I did not tell you how the framework of our house is held together. It is by white shining bands, called ligaments. These fasten the bones together very much as do the braces of a house which you see nailed at the corners of a wooden house-frame, or where two pieces of wood are joined together, end to end; so we may call these lig-

aments the braces. The framework of our House Beautiful must not only be strong,[7] but it must also be movable, so these braces should not hold it rigidly in one position, but allow of motion, in various directions, at those places where the different bones come together, which are called joints. [8] Some of the joints do not move, as those in the head. These are called immovable joints. [9] Of the movable joints there are the hinge joint, as at the elbow; and the ball-and-



KNEE-JOINT ANTERIORLY.



KNEE-JOINT POSTERIORLY.

socket joint, as at the shoulder. [10] Where the ends of the bones come together to form a joint, they are tipped with cartilage, so they will be smooth, and at the same time elastic, so that we will not jar the brain when we jump.

[11] Sometimes, as at the knee, they are enclosed in a sac, and then bound in place by the ligaments; [12] but with all this, they would not move if it were not for the muscles. So it is time for us to begin the study of the

muscles. A book which I have just looked into says "A voluntary muscle is the most highly organized, and is possessed of the most varied endowments, of all living structure." I wonder if we can find out what that means? I think it means something like this: That muscles are, in their structure and in the ability they have to do things, the most wonderful parts of our beautiful house. [13] The largest part of our bodies is made up of muscles, and they use up the most of the food which is carried to all parts of the house by the housekeeper, Blood.

[14] They are made up of many tiny fibres, and you will understand what fibres are if you will take a spool of white cotton and untwist a thread. You will first find that the one thread is made of three finer threads twisted together, and each of these is made of two threads; and if you pick it to pieces still further you will find that each of these is made of innumerable short, fine pieces. Each one of these is a fibre. [15] Muscles are made very much as thread is made, of little bundles of fibres. [16] But each muscular fibre is wrapped up in a thin blanket of its own. [17] This blanket is called a sheath, because it incloses the fibre as the sheath of a sword incloses the sword. [18] This sheath of the fibres of muscle is called by a big name,—*sar-co-lem-ma.*

[19] These little fibres, each in its coat of sarcolemma, are gathered into bundles, not twisted together as thread, but lying side by si 'e, and it is these bundles which we call muscles. Seventeen hundred of these fibres make a bundle an inch across in you

young folks, but they grow as you grow, and when you are of full stature it will not take more than five hundred to make an inch. [20] They are made up of other little fibres so small that they are known as *fibrillæ* or little fibres, and it would take many thousands of them to make a bundle an inch thick. But, [1] small as they are, fluids circulate through them, and it is in them that oxygen is consumed and carbonic acid given to the blood; and heat is the result; [22] so these fibrillæ might be called stoves. But they are more than stoves. Are they electric batteries? On a cold day, if you shuffle your feet over the carpet, you can collect enough electricity to send a spark from your finger to the nose of your companion, and make you both jump. But now I want to talk about the bundles of fibres which are our walls or muscles.

When all the fibres that make a muscle are gathered together they are inclosed in another sheath, which is named the *perimysium;* [24] *peri* meaning around, and *mysium* the muscles.

[25] Between the fibres in the muscles, and between the muscles themselves, fat is always to be found. [26] You scarcely need to be told that the muscles are supplied with arteries, veins, and capillaries. The latter are smaller in the muscles than elsewhere in the whole system. [27] The muscles are attached to the bones by strong white bands, called tendons. You can see the tendon in a leg of beef or mutton. It is white and shining and hard, not at all like the red muscle which, in an animal, we call the lean meat.

[28] These muscles, lying in various layers around our

bones, are what give to us our shape. When packed in fat they give a beautifully rounded outline to the human figure; but when there is but little fat the figure looks angular. [29] They grow with use, and on the arm of a blacksmith we can see a huge muscle swelling up when he shuts his hand and bends his elbow. On the legs of those who walk or run a good deal, especially if they walk on their toes, a muscle swells out and makes a fine calf. [30] Around the trunk of the body they are arranged in layers, some going around, others up and down, and still others in a diagonal direction. [31] This arrangement makes a fine protection for the internal organs, as well as being an excellent plan for accomplishing other effects.

There is one practical thing which you can learn from this study of the muscles. [32] If you think that the walls of your especial house are not strong enough nor thick enough, you can make them both thicker and stronger by using them judiciously; that is, according to your age, strength, and condition. [33] But if you overwork your muscles, the cells will be destroyed faster than they can be renewed, and weakness instead of strength will be the result. The walls, instead of being rebuilt constantly with new material, will become partly filled with worn-out matter. [34] Sometimes it is rest that is needed to build the walls, for during rest the old material is removed and fresh, living matter put in its place.

[35] It is wise to build up firm, strong walls, for we can not have much beauty or great ability for usefulness with soft, flabby muscular tissues. [36] If we

should see a man putting strong iron bands around a handsome house, we should at once take it as a confession that something was wrong in its construction that it thus needed external support, and we should probably blame the architect who had erected a building so weak that it could not stand alone. [37] But the Architect of our House Beautiful never makes such mistakes. If we find it needful to put on external supports it is an evidence that we have not properly used our muscles, and this is a confession of weakness, and also of ignorance. Let us trust our wise [38] Architect and use the muscles He has given us, wisely use them, in work or in play, and at all times pride ourselves on our ability to stand erect and walk uprightly.

CHAPTER IV

THE SERVANTS.

DID you ever think that a minister and a servant are the same thing? [1] A minister is one who serves, and a servant is one who ministers unto another. To be a servant is, therefore, sometimes a very high calling, and to serve well may be the most important work of our life. [2] The happiness, growth, and progress of the world depend upon its servants, both public and private; and the comfort and welfare of our House Beautiful depend upon the integrity of its servants. They are comprised under two heads: [3] those who wait for orders before doing anything, and those who understand always what is required of them, and work night and day without waiting for commands. The first we call the voluntary muscles, the second the involuntary muscles. [4] It is the voluntary muscles which have grouped themselves around us to form our walls, to protect us from injury, to strengthen our framework, and which carry us from place to place as we order them. We often laugh at the snail because he carries his house on his back; [5] but when we think of it, we see that we do the same thing. We never go out without taking

MUSCLES OF THE FRONT FIGURE.

B. Mastoid Muscle ; B. Deltoid—the Muscle covering the Shoulder Joint ; C. Biceps—Two-headed Muscle of the Arm ; D. Pronator—Pronating Muscle of the Arm ; E. Supinator—S pinating Muscle of the Arm ; F. Flexor—Flexor of the Wrist ; G. Palmaris—Bending Muscle of the Hand ; H. Flexor—Flexor of the Wrist ; I. Large Muscle of the Chest ; LL. Rectus—Straight Muscle ; M. Linea Alba-White Line ; OO. Sartorius—The Tailor's Muscle ; W. Rectus Femoris—Straight Femoral Muscle.

our house along. In fact, the owner and master of the House Beautiful can never go away from home, so it is no wonder he sings,

"Be it ever so humble, there is no place like home,"

for there is no other place for him in this world. Ought he not, then, to be very thankful to the strong, willing, ever-ready servants who serve him so faithfully all his life, and enable him to enjoy so much more than he could without their aid? I hope you will not get tired at being referred back to something I have told you before. The only way we can understand what is to come, is by remembering what we have previously learned.

I wish now to recall to your mind how many of the bones are made long, slender, and with enlarged ends. [6] To form a joint, these bones are placed end to end and held together by ligaments. [7] Each bone has upon each end a firm cushion of cartilage, which is somewhat like india-rubber, and these cartilages are oiled by a fluid which is made right there where it is needed. [8] We do not have to do as railroad men do, stop every little while and run around with an oil-can to oil the machinery; our machinery oils itself. [9] But the bones would not stay in place if the ligaments did not hold them fast. The same quality under different circumstances has different names. It is said of a donkey that he always wants to go in an opposite direction from that in which it is desired that he should go. This disposition in a donkey is

called *mulishness;* [10] in a boy or girl it would be called *obstinacy;* [11] grown persons might speak of it in themselves as *perseverance;* [12] but in the ligaments it is called *elasticity.* The ligaments like to have their own way; and when, by any movement of the muscles, the ligaments are stretched or bent, they at once try to go back to their own place; [13] and this very resistance to change is of great use to us in keeping us erect or upright. [14] If you feel up and down your back, you will find a row of knobs or projections, which are called the spinous processes of the vertebra, or backbone. [15] The spinal column is made up of twenty-six bony rings, each one with a bony handle, and these rings are placed one over the other, the handles all turned the same way. The ends of these handles are what you feel, and are called spines, or spinous processes. [16] These spines are fastened together by ligaments. [17] Between the rings of the backbone there are cushions of cartilage, which allow of movements in various directions. [18] When you bend forward, all these cushions on the front side of the spinal column are pressed together, and the handles on the other side are pulled apart like the sticks of a fan, and the ligaments are stretched. [19] But when you raise yourself into a standing posture, the ligaments contract, and, by their elastic force and obstinacy, we are held upright without our having to think about it. So you see that obstinacy in the right may not be a bad thing, but we need to be very sure that we are right before we are obstinate. These ligaments are never at a loss to know

whether they are right or not. They know that what they want to do is the right thing to do. [20] Their business is to resist change, that is, to be what we nowadays call conservative, and this for us is preservative.

[21] Sometimes bones get out of place, dislocated, the surgeons say, and these ligaments pull with all their might to get the ends of the bones back into place. [22] But the bones don't do anything to help, and while some of the muscles are helping, [23] others of them are pulling in a wrong direction, so that things go pretty badly until a skilful surgeon takes hold, and by turning the bones in the right direction, and in right relation to each other, the ligaments and muscles, guided in their efforts, pull the bones into place. [24] This shows us that it is necessary to have something more than a desire to help; it needs also to know how. Muscles have, to some extent, this quality of elasticity. [25] They have also tonicity, which means that muscles are always drawn up a little without our drawing them up by our will. We can contract or shorten our voluntary muscles as we wish; but if, when we were not using them, they were not in the least contracted, they would be very soft and flabby; and it is because they are always contracted a little that they are firm, and that is what is meant by tonicity, or tone of a muscle. [26] Muscles have also sensibility. But that does not mean their ability to feel pain; it means that when we take hold of anything, the muscles are able to judge how heavy it is; or when we push against a thing, they tell us

whether it is movable or whether it resists pressure. It is by the sensibility of muscles that we are able to judge how much strength it will take to accomplish something which we wish to do with our muscles.

[27] Contractility is the fourth property of muscle. This is the shortening of the fibres of which the muscle is composed, and by this means drawing together the two points to which the muscle is attached. A muscle is not fastened at both ends to the same bone, but there is usually a joint between. We can study that in the arm. [28] The muscles that move the arm below the elbow are fastened at one end above the elbow and at the other end below. [29] When the muscle on the front of the arm contracts, it bends the elbow; when the one on the back of the arm contracts, the elbow is straightened out. Sometimes when your mamma wants to hire a girl to [30] help in the house, she finds that the girl is very particular to inquire just what work she will have to do, and refuses to do anything that was not specified as her work. Well, the servants in our house are just so particular. The muscle that bends a joint will never straighten it, and so it is necessary always to have two sets of servants, who may be said to be opposed to each other, to work against each other. [31] The muscles which bend the joints are called *flexors;* those which straighten the joints are called *extensors.* [32] But, although these muscles are opposed, they never work against each other at the wrong time. They do not interfere with each other's work. If they ever do get obstinate, and all work at the same time, that makes the limb rigid so that it will not move at all.

[33] In contracting, a muscle does not change in size, but only in shape. It grows shorter, but at the same time it grows thicker and firmer. If we think how many things are to be done in our house, we will not wonder that there must be nearly five hundred servants, some to flex, some to straighten the limbs, some to wink our eyelids, others to move our tongue, to nod our head, to bend our back, to help us straighten up again, to perform all the varied motions which we make daily without thinking much about it. It will be impossible to describe to you fully all the motions made by the muscles, but we will consider for a moment the action in walking. [34] When we are standing erect the weight of the body rests upon the arch of the foot, and the heels and balls of the toes touch the ground. [35] The muscles of the leg, thigh, and body keep us erect; but when we wish to walk, then by muscular action [36] the body is made to lean forward, and this puts the two powerful muscles which form the calf of the leg upon the stretch, and they pull upon the tendon at the heel, and lift, not only the heel, but the ankle-joint and the whole body, and carry it forward; at the same time the other foot is lifted entirely off the ground and swung forward so as to be ready to take the next step. [37] In walking, running, or jumping, we are protected from being jarred, by the elasticity of the bones themselves, by the elasticity of the muscles, and by the cushions at the ends of the bones and between the rings of the backbone. [38] But to assist us in moving from place to place is not all that these servants do for us; even

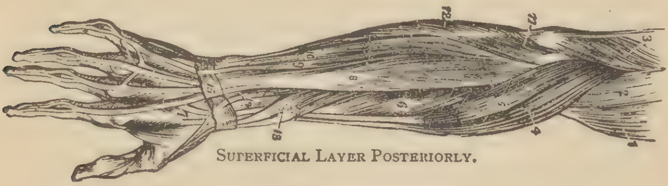
rest itself, in a sitting or standing posture, is due to the servants. [39] They hold us up, and to do this must be in a state of tension or pulling, which we have spoken of as tonicity, and they can never rest completely unless we lie down. That is why we rest so much faster when lying than when sitting down. Therefore, if we are ever in a hurry to get rested, we should remember this fact. [40] The servants of which I have been speaking are those which wait for orders, and are called voluntary muscles. [41] The involuntary muscles take charge of those movements which are not under our control, such as digestion, the beating of the heart, and the movements of respiration.

I have told you that the fibres of muscles are stoves, but they are something more surprising than that, according to the theory of a German investigator, they are musical instruments. He says that the contractions of muscles produce sound, and that he has really been able to hear the tones thus made, and that they are musical. We have often read of the "music of the spheres." That is the sound supposed to be made by the swift rushing of the earth and other planets through space. The Psalmist says, "The morning stars sang together," but we have always thought that to be only poetry and not fact. But why may it not be true? If our very muscles are singing at their work, we are set to music.

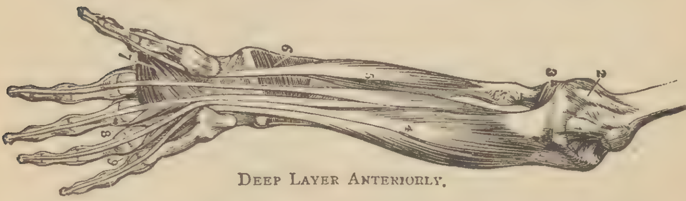
What a wonderful grand chorus must arise from all the active limbs of man and animals; a great song of praise, pealing forth in manifold strains,

"It is he that hath made us and not we ourselves."

We might consider the hand as a tool. It has as many as thirty muscular servants to move it. By experiment, you will find that the fingers do not act independently; this is because they are very intimately related through the nerves. One nerve goes to the thumb and to the outside of the first finger; another supplies the inside of the first finger and all



SUPERFICIAL LAYER POSTERIORLY.



DEEP LAYER ANTERIORLY.

of the three other fingers. The hand is aided by the mobility of the wrist, which is made up of eight small bones arranged in two rows. Those muscles which enable us to grasp solid bodies are attached above the elbow, and also along the two bones of the forearm. They terminate in long, slender tendons, which are fastened to the bones of the thumb and fingers. The muscular servants at first are awkward, but training enables them to do their work both well and rapidly. Frequent repetition gives such ease and rapidity that we do not have to think of the move-

ments we are making. Hence we say that muscles have a memory. The nerve terminations in the fingers, especially at the ends, are so numerous, that the sense of touch is very acute. Blind people learn tc read by passing the finger-tips over raised letters. A printer who sets ten thousand ems in a day, must make not less than thirty thousand motions and possibly as many as forty thousand. This would make his hand traverse forty or fifty miles in a day; yet by his touch he tells an "m" from an "n," and a "c" from a "t" instantly. Merchants judge of the proportion of silk, cotton, or wool in goods by the feeling, and those who count money judge of the genuineness of coin more by the touch than by sight.

The fingers are armed, protected, and ornamented by nails. There are animals who have hands like man's with the exception of the thumb. Said Newton, "In want of other proofs, the thumb would convince me of the existence of a God. Without the thumb the hand would be a defective and incomplete instrument." "The superior animal is in the hand, the *man* is in the *thumb*."

Beautiful hands are those which lift burdens from weary shoulders, which smooth the lines of care from anxious faces.

> "Beautiful hands are those that do
> Work that is earnest, and brave, and true,
> Moment by moment the long day through."

CHAPTER V.

THE SIDING AND SHINGLES.

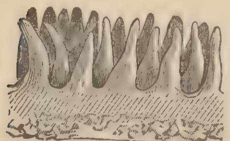
WHEN men build wooden framework for houses, and fill in between the studding with brick, and cover the whole with siding, little do they think that they are imitating the construction of our House Beautiful; but they are. We have seen this in studying the walls of the house, and you will notice the resemblance still more as we consider the siding. In these later years builders have sometimes discarded the old-fashioned weather-boarding, and have substituted a sheathing of rough boards covered with shingles, which latter overlap each other as on a roof, except that the lower ends are rounded to make them more ornamental. They are then protected and beautified by a coat of paint of any desirable color. Although this is patterned after our house, it does not begin to equal it. Stiff boards fastened on with nails are good enough for ordinary houses, but would never do for a house that can [1] walk, and run, and jump, and sit down, bend over on one side, and then on the other, and play ball, and hop-scotch, and do many wonderful things. [2] Such a house ought to have a covering that will bend and stretch without tearing, like india-rubber; that is just what it does. It is like a knit

garment that fits every part of the body at all times. [3] The spaces between the muscular walls are filled in with fat, and over this the siding or skin is stretched and fastened, not with nails here and there, [4] but everywhere rather loosely, so that in moving it will not break its fastening, nor tear apart. We should not find it much fun to play, if we were all the time pulling out the nails, or tearing holes in our siding, would we ?[5] The sheathing of our House Beautiful is the *corium*, or true skin.[6] It is composed of two layers, one of which is made of bundles of fibres interlacing with each other in every direction. [7] Some of these fibres we find to be muscular, and it is their business to pucker up the skin into what we call "goose-flesh" when cold air strikes the skin. This is thought by some to be a protection to the nerves.

ANATOMY OF THE SKIN.

1. The epiderma. 2. Its deep layer, the rete mucosum. 3. Two of the quadrangular papillary clumps composed of minute conical papillæ, such as are seen in the palm of the hand or sole of the foot. 4. Deep layer of the derma, the corium. 5. Adipose cells. 6. A sudoriparous gland with its spiral duct, as are seen in the palm of the hand and sole of the foot. 7. Another sudoriparous gland with a straighter duct, such as is seen in the scalp. 8. Two hairs from the scalp, inclosed in their follicles; their relative depth in the skin is preserved. 9. A pair of sebaceous glands, opening by short ducts into the follicle of the hair.

[8] The layer outside of this is called papillary, because it is made of little elevations, or papillæ, which contain the blood-vessels of the skin. [9] You can see the rows of these papillæ on the ends of your fingers. [10] Above the true skin is a membrane called the epidermis—*epi*, upon, *derma*, the skin. [11] This is also made up of two layers, in the lower of which is found the coloring matter which gives the complexion its tint. In the negro this pigment, or coloring matter, is nearly black. [12] You have often heard it said that "beauty is only skin deep"; but complexion is not skin deep, for when this inner layer of the epidermis is removed it is found that the true skin of the negro does not look different from that of a white person. [13] The outer layer is called the horny layer. [14] It is made of hard, flattened cells overlapping each other, and these are the shingles on our walls. [16] The use of the epidermis is to protect the true skin, and it is thicker in some places than in others, and grows thicker by use. [17] This is the cause of callous places on the hands of laborers. [19] Very often different parts of our house serve more than one purpose, and this is true of the skin: it not only protects us and keeps us warm, but it also helps to keep us cool.



THE PAPILLÆ OF THE SKIN.

[20] We might call the skin the manager or governor of the temperature of the body, which, by the way, is a most important office, for if the blood gets too hot, and remains so for any great length of time, the owner may abandon the house forever.

[21] This cooling process is accomplished by the sweat-glands, which are located under the true skin. [22] They are little tubes, which at one end open obliquely on the surface, and at the other end are coiled up in round balls under the skin. [23] If all these coils and tubes were straightened out and laid end to end, they would make a tube over ten and a half miles long. They are more numerous in some parts of the body than in others. [24] On the cheeks there are about five hundred, while on the forehead there are more than twelve hundred to the square inch; and on the palms of the hand more than three thousand. [25] Upon the whole surface of the body there are over two millions of these little doors, through which vapor is constantly passing, and with it worn-out material. [26] We don't see this vapor, and so it is called "insensible perspiration." [27] But, invisible as it is, it has been collected and weighed, and it is found that as much as two pounds are eliminated in twenty-four hours. [28] During severe exercise the glands act more rapidly, and drops of water collect on the surface, and as much as four or five pounds have been thrown off, by a laborer when working before a hot furnace, in an hour. [29] Under the influence of external heat the glands act in the same manner, and protect the body from injury by covering it with a coat of moisture, so that men have even been able to stay without harm in an oven hot enough to roast a piece of meat, and actually to remain until it was done. [30] What a wise and beneficent arrangement for us it is, that this regulator of the temperature of the body is always

on duty, and, without instruction or any forethought on our part, keeps the body always at ninety-eight degrees. [31] The watery parts of the perspiration are carried off in vapor, but the solid materials, about five parts in a hundred, remain upon the surface of the skin, and tend to stop up the mouths of the glands; so we can readily see the importance of frequent bathing. [32] The great danger arising from closing all of these mouths at once, is illustrated by the well-known fact of a little child's death having been caused, by gilding the whole surface of its body that it might represent the "Gilded Age." [34] The nails are appendages of the skin, and have two layers like the epidermis. [35] The under layer remains always the same, but the outer or horny layer is constantly growing. [36] The nails are a protection to the ends of the fingers and toes, and are also very useful in untying strings, opening pocket-knives, and in doing other necessary work.

[37] In England houses are sometimes roofed with straw, which is put on so thick and close that it will shed rain. This kind of a roof is called a thatch. [38] Our House Beautiful has a thatched roof, but it is made of hair instead of straw. This roof has various colors: it may be brown, or black, or gray, or even white, in old houses; little new houses have no thatch at all. In very old houses the thatch sometimes gets all worn off. This we call being bald-headed. [39] We ought to take good care of our thatch, keeping it clean, and brushing it, to keep it well oiled. [40] There are little glands at the root of each hair whose busi-

ness it is to make oil for it, and brushing them gently stimulates them to work. [41] If we furnish the oil, they will get lazy and make none, and no oil is so nice for the hair as that which these glands make.

[42] There is a little thatch over the windows of our house; in fact, when we come to study into the matter we find that the whole house is covered with hairs. Upon the body they are soft and downy, and almost colorless. They form a pretty fringe to the window-awnings, and they grow upon the faces of men, and protect the throat, and make a strainer under the nose which we call a mustache. [43] The hair is an appendage of the skin, and like it has a [44] fibrous substance and epidermis. [45] The downy hairs grow from the true skin, but the roots of the larger hairs penetrate much deeper. [46] Each hair rests in a tiny pocket, at the bottom of which is a papilla which might be called the mother of the hair, for from this papilla the hair is produced. [47] Each hair is a tube, and the coloring matter is in the centre. [48] The root of the hair is a bulb, and a little oil bottle empties into each hair-pocket or follicle. [49] These oil bottles are termed *sebaceous glands*, and they are found all over the body as well as on the head. [50] They help to keep the skin soft and flexible.

[51] The Bible says that the hairs of our head are all numbered, and one man has tried to find out how many there are. He did not count every hair, but he counted how many grew on a square inch, and from that he made an estimate that there are one hundred and twenty thousand hairs uoon the head.

St. Paul says that long hair is a glory to a woman and all women are justly proud of a wealth of long, soft hair. It is not often that hair grows longer than three feet, but I once saw a woman whose hair reached the ground. Men are equally proud of a long beard. The ancient patriarchs are represented with snowy beards reaching down over their breasts. I once saw a beard three feet long. The beard was held in great honor by the old Romans. Once when a horde of northern barbarians invaded Rome the old men of the senate sat motionless until one of the Vandals plucked a senator by the beard. The indignant Roman avenged the insult by striking the insulter dead, and universal carnage began. The beard was given man as a protection as well as an ornament, and should never be shaven. A great deal of poetry has been written about hair, from the golden baby curls to the "frosty pow" of age. Gray hairs come with years and cares, but we should never feel ashamed of them, for "the hoary head is a crown of glory."

CHAPTER VI.

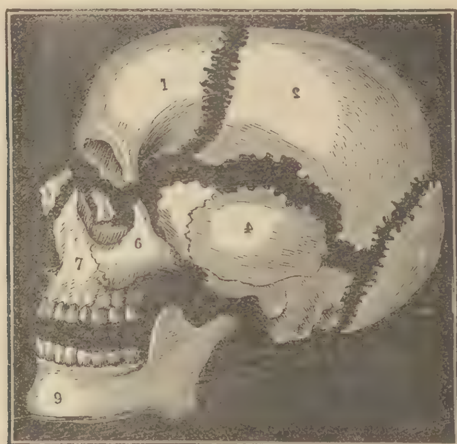
THE OBSERVATORY.

WE have watched our House Beautiful as it advanced through the various stages of erection, from the foundations up through the framework and walls to the outside covering, and now we begin to ask how it is to be completed. [1] And we find that this wonderful structure is surmounted by an observatory more marvellous than any other part of the building. [2] For it is here that the Master resides. It is quite fashionable to have a portion even of private residences extend above the rest, and to this is given the name of an observatory. Generally, there are windows on all sides, and often the roof is a dome of glass, so that the observer may look, not only on every side, but also at the heavens above.

The observatory which crowns the House Beautiful is a marvellous structure; its walls are more complicated than those of any other part of the house. [3] They are made of twenty-two bones firmly locked together so as to make them very solid.

I said all locked together. [4] But there is one bone that is movable, and only one. That is the one which forms the lower framework of the pink folding-doors, we call it the lower-jaw. Did you ever think that when you chew your food, you do not

move your upper-jaw at all? [5] The lower-jaw is joined to the rest of the skull by a movable joint a little in front of the ears. You can feel it if you put your finger there and open and shut your mouth. [6] The bones of the skull are divided into those of the face and those of the cranium. [7] The cranium is formed of eight thin, beautifully curved bones. [8] The



THE SKULL.

1. Frontal bone. 2. Parietal. 3. Occipital. 4. Temporal. 5. Nasal. 6. Malar. 7. Upper Maxillary. 8. Ethmoid. 9. Lower Maxillary.

one at the back is called the *occipital*. If you should ever hear that some one had injured his *occiput*, you would know that that meant the back of the head. [9] The sides of the head are formed by two *parietal* and two *temporal* bones. [10] The upper and front part is formed by the frontal bone which makes the arches over the two windows.

[11] On the outside, the skull is covered with a tough membrane called the scalp, to which is attached the beautiful thatch which we know as the hair. [12] As we examine this observatory, we are struck with the fact that there are no skylights, and only two windows, and they are both close together and on the same side.

How, with this arrangement, is the observer to obtain an extended view? [13] The Architect knew well what He was doing when He mounted the observatory on the short, slender, circular tower known as the neck. You remember how, in the fable, the giant Atlas held up the sky on his head and shoulders. [14] Our observatory has an atlas to hold it up, but it is not a giant, only a ring of bone.

[15] It is the very upper vertebra. [16] It differs from other vertebra in not having so much bony material, but having instead, a larger hole in the centre. [17] This hole is divided by a band. [18] Behind this band the spinal cord passes down into the other vertebræ below, and in [19] front of it a bony point of the second vertebra passes up and [20] makes a pivot on which the observatory can turn round. [21] This second vertebra is called the axis.

[22] The atlas has two cup-like depressions on its upper surface upon which fit two points of the occipital bone when the head is tipped backward. [23] The neck is formed of various muscles, whom we will call servants, whose [24] business it is to move the head in many directions; [25] so that our observatory can be turned half round from one side to the other, it can

be tipped forward so that the windows look toward the ground, or it can be tipped backward so [26] that the windows are directed heavenward, and thus no skylights are needed.

[27] The cavity of the skull is so irregular in shape that it is difficult to tell how large it is, but it is quite large enough to hold a quart or three pints of fluid. And what does this cavity contain? Something which has excited the wonder and admiration of the wisest men of the world. During centuries men have studied it, and yet not much has been learned about it. [28] We know it under the term brain. It is very difficult to give in writing a clear idea of the brain, even of its appearance and shape. If you could see a brain you would be better able to understand it, but as you can not we must be content to learn all we can by a description. [29] First, we find that the bony cavity of the skull is lined with a dense fibrous membrane called the *dura mater*.

THE BRAIN.

a, *a*. The scalp turned down. *b*, *b*. Cut edges of the skull bones. 3. The dura mater suspended by a hook. 4. The left hemisphere.

[30] You have studied Latin, and will be able to translate that, hard or durable mother.

[31] Inside of this is a delicate fibrous membrane almost like a spider's web for thinness, and on that account is called the *arachnoid*. This will recall to your mind the fable of the Princess *Arachne*, who was famed for spinning, and because she rivalled Minerva was changed by that goddess into a spider.

[32] Inside of the arachnoid is a delicate fibrous membrane full of blood-vessels which is called the *pia mater*, or soft mother.

And now we come to the brain itself. How shall I describe it to you? [33] A great French writer says it is like a beautiful white camellia, and calls it the flower of flowers. That is very pretty, and yet it does not give us a very definite idea, as to its appearance. The brain of a chicken, calf, or other animal would give you some idea of how the brain of a man looks. [34] You would see that it is a rounded mass, not unlike dough in color, not smooth on the outside, but with a great many little creases all over the surface. It is crumpled, or folded up, to fit into the irregular space, and if stretched out smooth, it would spread over a far greater surface.

A baby's brain is more nearly smooth on its outer surface than that of a man. As the baby learns and increases in intelligence, its brain becomes more wrinkled. [36] The number and depth of these creases or wrinkles are in proportion, it is said, to the intelligence of the person.

[37] The brain is composed of white [38] matter on the

inside, and gray matter on the outside. [39] The gray matter is made up of cells, [40] and in them is generated a force which we call nerve force. These cells are of two sizes, and it is thought that the larger ones direct muscular movement, and the smaller ones control the powers of thought, but this can not be proven. [41] The white matter is made of fibres, and conducts the nerve force from the cells. [42] The brain substance is soft, almost like jelly, only it has these white fibres running through it. So if we had a fine gray jelly, with white threads through it, it would be very much like the brain in consistency.

[43] At birth the brain of a boy weighs about eleven ounces, that of a girl ten ounces. A man's brain weighs about forty-nine ounces, that of a woman forty-four. Some people think that the size of the brain has much to do with the intellect of the person, and they tell of the brain of Daniel Webster, and of that of Abercrombie, each of which weighed nearly sixty-four ounces, or nearly four pounds.

But Gambetta was certainly a great man, and his brain, as has been reported in the papers, weighed less than that of an average woman. When we study the different parts of the brain, we find that the very important parts called the *medulla oblongata* and *pons varolii* are larger in women than in men, weighing in men ninety-eight hundredths of an ounce, in women over an ounce.

I guess after all that it is quality, not quantity, that determines the working power and value of brain, and

it makes little difference whether that brain belongs to a man or a woman.

[44] The brain is divided into the great brain, [45] which occupies the upper and front part of the cavity of the skull, and is eight-tenths of the whole mass, [46] and the small brain, which is located at the lower part or base of the skull. [47] The two are connected by a bridge called the *pons varolii*, because a man named Varolius first described it. What girl ever dreamed that she had a bridge in her head. Is it any wonder that she should sometimes have the headache? The lower brain is connected with the spinal cord by a portion called the *medulla oblongata*.

The cells of the brain are little points of matter, like jelly, each with a dot in the centre. There are nearly a billion of them. Does not that make you exclaim, "Upon my word!" Some of these cells have one, two, or three tails, while others are tailless. [48] They are held together by these tails. [49] Where a number of them collect in a cluster they are called a *ganglion*, plural *ganglia*. [50] The white fibres connect not only the cells, but the ganglia, and thus form a kind of battery. And what is a battery? If we dissolve bi-sulphate of mercury in water, and then put into it a piece of zinc and another of carbon, the fluid will eat up the zinc. This we call a chemical action, and by it is produced an invisible fluid, which we can feel if we attach a piece of metal to both carbon and zinc. This fluid we call electricity, and we can conduct it along a wire any distance and make it carry messages for us to every part of the world. [51] The

cells of the brain and spinal cord act as such a battery producing a nervous fluid, which is conducted along the white fibres, and [52] by this means the owner of the house is enabled to communicate with all parts of his dwelling, as well as with the outside world.

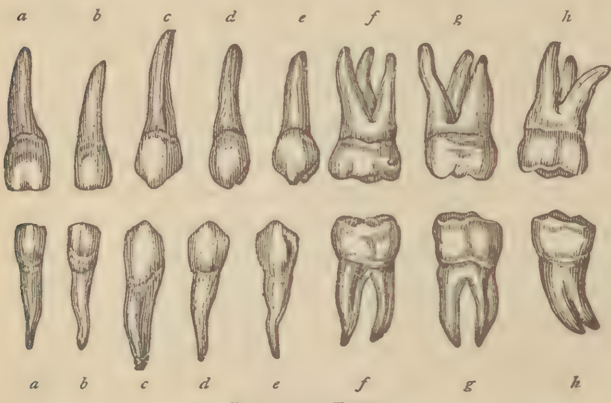
CHAPTER VII.

THE HALL.

A GREAT number of visitors who come to our House Beautiful are intending to go to the kitchen. [1] They enter by the front door, perhaps I should say doors, for there are two of them. [2] They are, or ought to be, of a bright red color, and they can do many remarkable things. [3] They can whistle. "Whistle?' Yes. "Doors squeak sometimes, but I never knew a door to whistle." These doors do not squeak. The hinges never get rusty. They oil themselves. But they can do disagreeable things: they can whisper, and they can pout; but then they can kiss.

[4] The bright red covering of the lips is called mucous membrane, and like the skin it is made up of two layers. [5] It is more delicate than the skin, and lines all cavities which communicate with the outer air. As the folding-doors open we see a double row of attendants waiting to receive all visitors. When we enter the office of a hotel, we find the clerk ready to answer our questions and to assign us a room. A servant hastens forward to take our satchel and wraps, and another to show us to a room, and when being so waited upon we feel that we are of some importance.

[6] Visitors to the House Beautiful are received by thirty-two attendants, all in white uniforms, who proceed at once to remove the wraps of the visitors, and to prepare them to appear before the cook in the kitchen, who is quite particular about his guests. These thirty-two attendants you will have no difficulty in recognizing as the teeth. [7] The four in the centre are called the incisors. [8] On each side of these

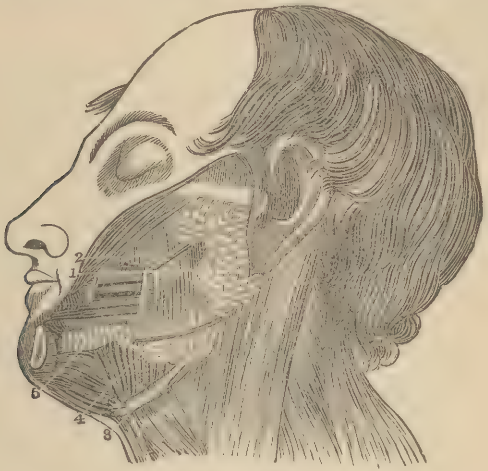


PERMANENT TEETH.

a. Central incisor. *b.* Lateral incisor. *c.* Cuspid, or canine. *d.* First bi-cuspid. *e.* Second bi-cuspid. *f.* First molar. *g.* Second Molar. *h.* Third Molar.

are sharp, strong fellows, who are called eye-teeth, or canines, because they look like the great tearing teeth of the dog. [9] Next stand two, which are called bi-cuspids (two-pointed), because their roots have two points; [10] and next to these are three strong, broad fellows, called molars or grinders. [11] When food is put into the mouth the incisors cut it, the canines tear it, and the molars grind it; and that is not all

for back of this double row of soldierly guards is one in a pink uniform, who rolls the food over and around and says, "That tastes good." We might be afraid of him did we not see that he is fastened to the floor. He has an important work to do, but our business just now is with the strong white teeth.

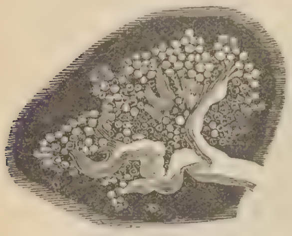


THE SALIVARY GLANDS.

1. The parotid gland, extending from the zygomatic arch of the cheek-bone to the angle of the jaw below. 2. Duct of the parotid gland. 3. The sub-maxillary gland. 4. Its duct. 5. Sub-lingual gland.

[12] In little new houses we find none of these attendants, for their visitors have no wraps to be removed, and do not need to be ground and forced to be fine enough to be presented to the cook. [13] But a number of other active assistants are connected with the hall. They are very valuable helpers of the cook. Their family name is saliva, and their home is in the sali

vary glands. These glands are called *sub-lingual*, meaning under the tongue; *sub-maxillary*, under the jaw; and the *parotid*, near the ear.

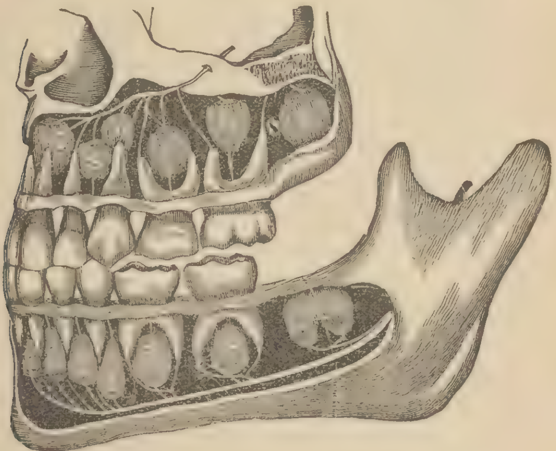


Parotid Gland.

Down in the dining-room appear other assistants, who are ready to perform their work, and need the help of the saliva;[14] and then some little fellows, who have been lying asleep in little cradles in the gums, wake up and begin to push their way out into the world. [15] Twenty of them come one after another, ten above and ten below,[16] and then baby is ready to begin to receive the same kind of company as grown people. Then, and not till then, can he eat firm, dry foods; [17] for without a mixture of saliva, [18] starch can not be digested, for starch must be changed into sugar before it can be used in building up the house, [19] and this is done by the saliva. It also makes dry food slippery, so that it can be easily swallowed. About three pints of saliva are secreted in twenty-four hours. [20] Under these twenty teeth there are thirty-two other teeth, also asleep in their pretty pink cradles; and after seven years or so they begin to want to see the world, and one after another they push at the first teeth above, until they get loose and fall out.

I think we ought to be very thankful to these second teeth that they do not all grow at once, and so, perhaps, leave us for a while with neither the old teeth nor the new ones. They take it quite leisurely

[21] The first to appear is the first molar, at about six years of age. [22] The middle incisors come at about seven years of age. [23] The other incisors at eight. Then, at about nine years, come the first [24] bi-cuspids; and the second bi-cuspids at ten. The canines make their appearance at eleven or twelve, the second molars at twelve or thirteen, while the last, or wisdom



INFANT TEETH AND RUDIMENTS OF THE PERMANENT.

teeth, do not come until from the seventeenth to the twenty-second year or later.

[25] There are no more teeth asleep beneath this second set, and when they leave us we shall have no teeth, unless we get the dentist to make us some, and, skilful as he may be, he can not do quite as well as the Great Architect did. [26] The teeth are not bone, but a fine quality of ivory. They are appendages of

the mucous membrane, just as the hair and nails are appendages of the skin. [27] Each tooth sets in a pocket in the gum, which is lined with mucous membrane.

The white coat of the teeth is a hard substance, called enamel. [29] Inside of this is the substance of the tooth, which is a hard material, called dentine or tooth-ivory. [30] This is hollow, and within its cavity are blood-vessels and nerves.

[31] The part of the tooth which we see is called the crown, that which is enclosed in the gum is the fang, and between these is the narrow part called the neck.

[32] We sometimes see these worthy assistants with uniforms discolored and stained, with holes in them, and looking altogether quite disagreeably neglected. As we can not have them renewed when they wear out we ought to take the best of care of them. If food is allowed to hide between the teeth it decays and causes the teeth to decay, and it should therefore never be permitted to remain, and at the same time it should never be harshly removed. Pins or metal toothpicks wear out the enamel, and so do great injury. Quill or wooden toothpicks are the only ones that should be employed. These pretty, useful servants should not be used for such work as cracking nuts, for they may be broken or the enamel cracked, in so doing. They like to have a bath every day, and to be scrubbed with a soft brush and soap,—nice white soap, or a powder made of soda and myrrh,—and if so carefully attended will take great pride in peeping out, with their shining white faces, from behind the rosy folding-doors.

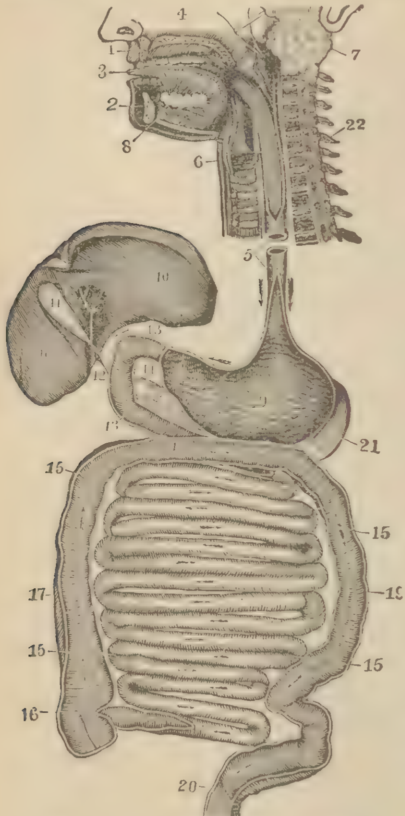
CHAPTER VIII.

THE KITCHEN.

As we pass the white attendants who welcomed us we enter the hall and looking around we see pink walls on either side, and over these a beautiful arched roof called the roof of the mouth or the hard palate. At the back of the hall hangs a pink curtain, and beneath it is an arched doorway, and from the middle of the arch we see hanging down a "little red tongue." [1] This "little tongue" is called the *uvula* and has an important office. Passing under the arched doorway we enter a room, which has no floor, and which is called the *pharynx*. In the roof of the pharynx is an opening leading into the nose. This opening is just back of the uvula. When food is being swallowed, the two halves of the pink curtain in the back of the hall are drawn together, and at the same time the uvula is stretched back and closes the opening into the nose, so that the food can not find an entrance there. There are two pairs of stairs leading out of the pharynx. One pair of these stairs is called the *œsophagus* and leads into the kitchen. [2] These are very queer stairs, indeed. You did not see any place to go down, for the walls of the œsophagus lie close together; but [3] as the food passed

into the pharynx, an opening appeared in the back part of the throat, and the food began to descend. Do you notice, as we go down, that the walls expand and then close behind us to push us in? Such a getting down-stairs as that you never did see! ‘When we reach the bottom we find a little round door held together by a "puckering string"; and when it opens we find ourselves looking down into the kitchen from the ceiling. How are we to get into the room? We must just drop down. "Well, that is funny."

Oh! you don't know how many strange things we



1. Upper Jaw. 2. Lower Jaw. 3. Tongue. 4 Hard Palate. 5. Œsophagus. 6. Trachea. 7. Parotid gland. 8. Sub-maxillary gland. 9. Stomach. 10. Liver. 11. Gall-bladder. 12. Hepatic duct. 13. Duodenum. 14. Pylorus. 15. Small intestines. 16. Ileo-coccal valve. 17. Ascending colon. 18. Transverse colon. 19. Descending colon. 20. Rectum.

shall see in this house. It is more wonderful than any fairy castle you ever heard of. And the best about it is, that all I tell you is true. Now we are in the kitchen, and the door in the ceiling above us has closed. We look about us. This room is unlike any you were ever in. [6] It is not quite oval, but, as scientific men say, it is "irregularly conical." The floor is not flat, and there is not a corner in it. It is a

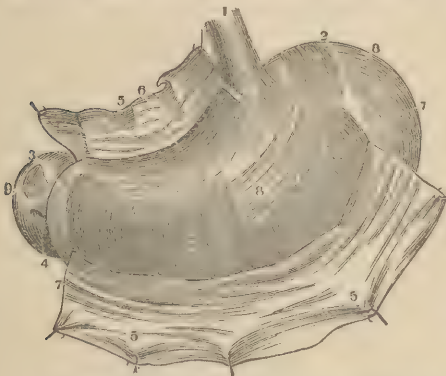
FOLLICLES OF THE STOMACH.

good deal like the inside of an egg in shape, but not in color; for it is a pretty pink, or it should be. Sometimes when you do not use it well it gets a fiery red. It was quite small when we came in, but did you notice that it began at once to grow larger? You have read of enchanted castles, where rooms grow smaller; and this one grows to accommodate the master of the house; for it certainly is an accom-

modation to have the kitchen get bigger when you send a quantity of food into it; and then, after the food is all cooked and sent to the dining-room, it grows smaller and folds itself up as it was when we came in. How does it do it? [7] Dou you see that the walls are not smooth, but have folds in them? [8] That is so, it can stretch; and when the kitchen is full the walls are smooth. Put on your big spectacles and look around.

[9] "Oh! the walls are full of little pits or hollows. And they are all over the floor, too! Some have six sides, and some have more." Yes; it looks a little like a honeycomb. Those hollows are the kitchen cupboards. "And where is the cook?" When the kitchen is empty he is never there; but as soon as we send down a particle of food to be prepared, he comes and opens the cupboards and takes out what he needs, and goes to work. "What is his name?" Gastric Juice. "But what is the matter?" The kitchen is beginning to move. [14] There are three walls to this room; one outside of the other. The pink inside wall is called a mucous membrane, the outside wall is a serous membrane, and between these is a muscular coat, which is made up of three layers [15] which have the power of contracting and expanding. [16] The outside layer contracts the long way of the kitchen, the middle layer the short way, and the inside layer contracts diagonally. [17] And this drawing together and stretching out of the walls gives the contents of the kitchen a churning motion, backward, forward, and "all through other," as I have heard people say.

You all know by this time that the kitchen is the stomach, and the cook is the fluid which digests the food. [18] This fluid is thoroughly mixed with the food by the churning motion, which continues as long as there is anything in the stomach. [19] The cook has a great deal of work to do, breaking up the meat and vegetables and dissolving some parts of them. After two or three hours he has mixed them up so thoroughly that you could not tell meat from potatoes.



Front view of the stomach, showing the greater extremity and the pyloric extremity. A portion of the peritoneal coat is turned back to show the muscular fibres. 1. Anterior face of the œsophagus. 6 A portion of the longitudinal fibres. 7. The circular fibres. 8. Oblique muscular fibres. 9. Portion of the duodenum.

[20] At the end of the room opposite the door where we entered there is another door, also held shut by a string (which is called a sphincter muscle), and this leads into a second kitchen, where there are other assistants of the cook, about whom we will learn in our next chapter.

[21] We have been talking about solid foods, and now I will tell you something odd about what is done with fluids which we send into the kitchen. [22] The walls drink them up. "How queer!" [23] Yes; and the

cook does not like to have much fluid sent while he is at work, as he must wait till the walls have absorbed it before he can go on with his cooking. [24] Then, too, if the fluids are cold, like ice-water, they put his fire out, and he has to wait until it is built up again. [25] He can not work unless his kitchen is at a temperature of about ninety-eight degrees Fahrenheit, and that we should call summer weather. The kitchen is kept at that temperature all the year round, no matter how cold it is out-of-doors, or how hot. What are the practical things we can learn from this visit to the kitchen of the House Beautiful? [26] First, that we ought to chew our food thoroughly, so that it will become mixed with saliva, and as much starch as possible be changed into sugar before it goes into the stomach; for Gastric Juice does not digest starch. That the big guard in the red uniform deceives us sometimes. He gets used to very unpleasant things, such as tobacco and alcohol, and says they are good; or he is very fond of sweets, and coaxes us to eat too much of them, and Gastric Juice rebels, and says he has too much to do. So we should not always listen to what he says. [27] Then we should not send too much food into the kitchen, even if it is wholesome, or the cook will get too tired to do his work well. [28] We should not send down food at all times of the day or night, but should be kind to the poor cook, who does his best for us all the time, and who needs rest as well as we. [30] When he is busy at work we should not put his fire out with cold water.

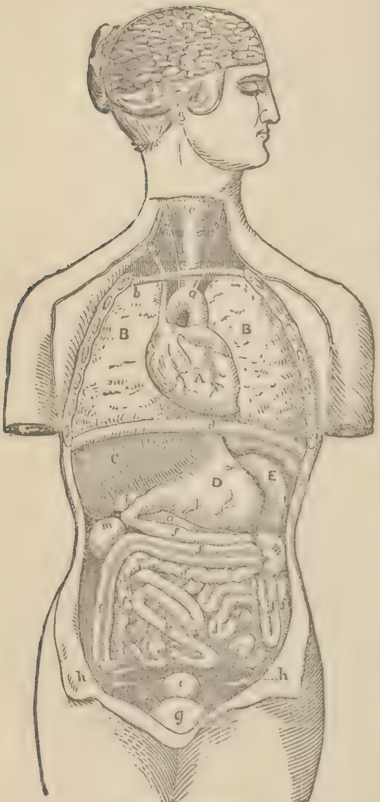
CHAPTER IX.

THE BUTLER'S PANTRY

BETWEEN the kitchen and dining-room in our House Beautiful is a very small room, which I have called the butler's pantry. The door between this room and the kitchen is, by scientific people, known as a sphincter muscle; but you will understand it better if I say it is like an elastic puckering string in the top of a bag. If you pull it open it draws itself shut. [1] This door is called the *pylorus*, a word made of two Greek words, [2] meaning a guard, and a gate, and that is just what the pylorus is: both a guard and a gate.

[3] As fast as Gastric Juice prepares the food it is strained through this gate into the pantry. The churning motion of the stomach sends the food round and round, and the pylorus knows just what to let pass through his gate. [4] If a particle of food is not thoroughly cooked or digested it is sent back for Gastric Juice to work at some more. [5] But if it be something that will not digest, as a prune-pit, and it keeps presenting itself at the gate demanding to be let pass, after a while the pylorus becomes irritated, and opens the gate for the offending substance. Just as mammas sometimes become vexed by the teasing of their children, and permit them to have what at first

they refused. It is not wise in mammas to do so, but the poor pylorus does the best it can. If this happens often the [6]pylorus becomes continually angry or irritated, and grumbles even when good, well-digested food asks to pass by, and so the master of the house is made to suffer pain. It sometimes happens that very dangerous enemies gain admittance to the kitchen and threaten the [7]life of the master. Then, if possible to do so, the pylorus, recognizing the murderous character of these guests, shuts up tight, and says: "You shall not go through"; and an alarm is raised, and some very strong servants of the house, called muscles, come to the help of the



VITAL SYSTEM.

A. Heart. B, B. Lungs. C. Liver. D. Stomach. E. Spleen. *m*, *m*. Kidneys. *g*. Bladder. *d*. is the diaphragm which forms the partition between the thorax and abdomen. Under the latter is the cardiac orifice of the stomach, and at the right extremity, or pit of the stomach, is the pyloric orifice.

pylorus, and the intruders are forced to go out the way they came in. This we call vomiting, and it is a very disagreeable process, but sometimes very beneficial; and we should be thankful that we are able so to expel our foes, even if it does make us suffer.

[8] It takes from three to five hours for Gastric Juice to get his cooking all done and the kitchen empty, then he takes a rest, and other servants take up the process of preparing the food. [9] A very important work is done in the butler's pantry. [10] The scientific name of this room is the *duodenum*, so called from a Latin word meaning twelve, because it is about as long as twelve fingers are broad. [11] It is fitted up with a very great number of shelves. [13] There are two assistants, who begin their work in this little room. One, named Pancreatic Juice, has his home in a room called the [14] pancreas, which lies back of the stomach. The other, called Bile, comes from a large and important room called the [15] liver. [16] Each of these assistants comes along a little hall which leads from his room, until they meet in a larger hall, and go on in quite a friendly way to their work in the pantry.

[17] Although they seem to be such good friends there is in reality a very great difference between the two. Pancreatic Juice is very obliging, and will do any kind of work that needs doing, while Bile is very particular, and will have little to do with anything but fats.

[18] All the food we eat is classed under four kinds: amylaceous, that is, starchy; saccharine, that is, containing sugar; oleaginous, fatty; and albuminous, that is, foods containing albumen—a substance like

the white of an egg. [19] Saliva digests starch. [20] Gastrice juice digests sugar and albumen; it breaks the albuminous coverings of food, and that may be said to be like the cook peeling the fruit and vegetables; it dissolves some kinds of food, softens others; it curdles milk, and oily substances are in the stomach churned up into very small particles; but gastric juice does not change starch, although it separates it from the albuminous material that may surround it. [21] Pancreatic juice, however, does not select his work. He does not ask whether the food is albumen, sugar, starch, or fat, but digests each and all.

[22] Bile, on the contrary, is just as aristocratic as saliva, and condescends to notice only the fats—that is, as far as preparing food for the dining-room is concerned; but he has other work to do besides that of digestion. [23] It is his business to see that everything goes on smoothly, and to keep things from spoiling. If he is sick, or lazy, and neglects his work, the food is apt to decompose, and spoiled food is very unwholesome. [24] Sometimes he gets worn out because he has so much fat given him to digest that he can not do his work well, and he complains in a way that the master of the house learns to understand, and knows that this trusty servant is out of temper, even if he does not know what makes him so; and this being out of temper the master calls "biliousness."

[25] Fat is our fuel. We need fat in the winter to keep us warm; but as the [26] warm days of spring come we need to keep up less fire; if we do not remember this, and continue to eat as much butter, fat

meats, and rich gravies as we did in cold weather, we need not be surprised if our cooks complain and warn us that we are not using them well. It is our duty to care for the welfare of all of the servants who work for us so faithfully in our House Beautiful. We should give them opportunity to rest; we should not overwork them, or call upon them to do impossible things, and so make them angry; for, although they always do the best for us they can, yet they will be revenged upon us and cause us to suffer if we abuse them.

You must not think that all this time while the food is in the kitchen, and in the butler's pantry, that none of it is used in building up or strengthening the house.

Most all cooks have a way of taking a little taste of this or that kind of food while they are at work. Some say they must taste now and then so as to know if they have it properly seasoned. But it is not the cooks in our house that take a taste now and then. They attend strictly to their own work. It is the walls of the kitchen and of the butler's pantry that help themselves to the food. Do you say that you can't believe that the walls of a house could eat food? It does sound strange at first. But it is true, nevertheless.

Did you ever come into the "old house at home" after it had been raining for some days, and find the brick wall on one side all wet because the trough at the roof leaked on the outside? Certainly you remember that. Now, had not the wall been eating the water? It could not have got wet in any other way.

In very much the same way the walls of our House Beautiful take up the fluid food.

There are millions of little mouths which are opened to take up the food which goes into the circulation direct, and this strengthens the person and cheers him up if he is suffering for food. So when one has been a long time without food, milk or soup is among the best things to give. And if you give a hungry person food you will now know that millions of these little mouths are saying in chorus, I thank you, I thank you.

CHAPTER X.

THE DINING-ROOM.

"WHERE is the man who can live without dining?" asks the poet. And it is a fact that the subject of dinners occupies a large share of the thoughts of both the old and the young, and how to procure them constitutes the chief anxiety of a great portion of mankind. In the humble cottage and in the grand mansion the dining-room is the pleasant centre of attraction for the family.

And our House Beautiful has a dining-room, which we shall find worthy of a visit. [1] It opens directly out of the butler's pantry, and is a long, narrow room, perhaps an inch or so in width, and about twenty-five feet long. [2] It is coiled and folded up like a rubber tube, to fit in a space which is called the abdominal cavity.

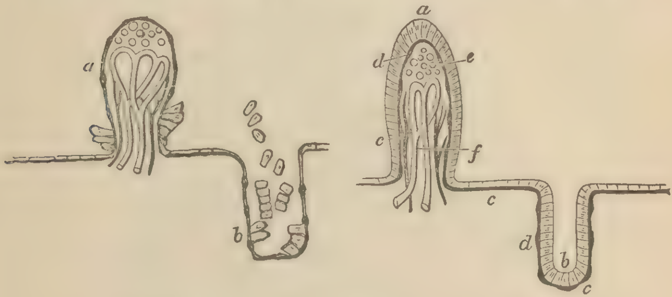
This dining-room has three walls, like the stomach. The muscular fibres are arranged, some running lengthwise and others running in a circular manner around this tube. The inside of the tube is lined with a thin, soft, flexible membrane or skin, which is folded or plaited up, so that if it were smoothed out straight it would not be less than fifty feet long; and its whole surface is covered with a vast number of little cupboards called follicles.

[3] The first two-fifths of the dining-room is called the *jejunum*, the [4] remaining three-fifths is the *ileum*, and both together are commonly spoken of as the [5] small intestines. [6] The dining-room is presided over by Intestinal Juice, another member of the Juice family, [7] and his duty is to complete what the others have left undone. The material with which he works is found in the little follicles, which are called the *follicles of Lieberkuehn*, and which are set close together through the whole length of the small intestines. They are little tubes with rounded ends below, and opening upon the inner surface of the intestine by mouths.

Follicles of the Ileum.

There is no sound of bell or gong when dinner is ready, for the people who are to eat are never away playing croquet or riding bicycles, and never need a half hour's warning in order to get clean faces and smooth hair before coming to the table.

They are always in the dining-room, and are usually ready to eat. They are very, very little people indeed. You could not see them without your biggest spectacles. They are so small that there are from forty to ninety of them in the one hundred and forty-fourth part of a square inch. Each one of these [6] little-folks is called a *villus*, and altogether are *villi*.



The Villi.

Chylification.

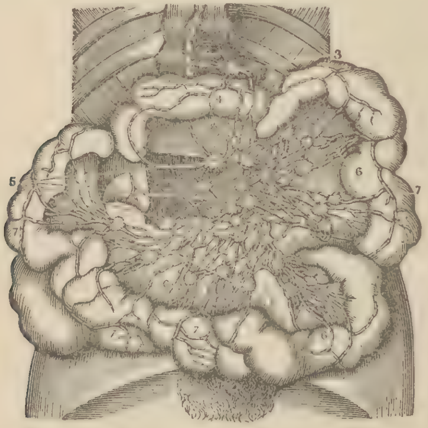
A diagram of the mucous membrane during digestion and the preparation of chyle. *a*. A villus, turgid and erect; its protective epithelium cast off from its free extremity; its absorbent vessels, lacteals, and blood-vessels turgid. *b*. A follicle discharging its epithelial cells.

Absorption.

A representation of the same mucous membrane when chylification is not going on. *a*. Protective epithelium of a villus. *b*. Secreting epithelium of a follicle. *c*, *c*, *c*. Primary membrane, with its germinal spots, or nuclei, *d*, *d*, *e*. Germs of absorbent vesicles. *f*. Vessels and lacteals of villus.

They are attached to the walls of the dining-room, and are like little hairs, so close and fine that under the microscope they make the walls have a velvety look. [9] Each *villus* has a mouth, and sucks up the food that is passing through the dining-room. [10] The food by this time has become a milky fluid, very different in appearance from the variety of articles of which it is made, and is called Chyle.

Custard is a word meaning eggs, milk, and sugar beaten together and cooked, so that it is ready to be eaten. And chyle is the name for all the food we eat after it has been beaten and churned together and prepared by our various cooks, through their process of cookery, which we term digestion, for the use of



MESENTERIC GLANDS.

1. Thoracic duct. 2. Section of the aorta. 3. Glands around the aorta which receive the lymphatics from the intestine and give off vessels to the thoracic duct. 4. Superficial lymphatics on the intestine. 5, 5. More lymphatic glands receiving vessels from the intestine. 6, 7. Lymphatics from the intestine and mesentery.

these little *villi*, whose whole duty is to eat that we may live.

[11] It is really true that they eat for us rather than for themselves, and so they do not keep what they have eaten, but [12] pass it along through numerous little halls or ducts until it reaches the mesenteric

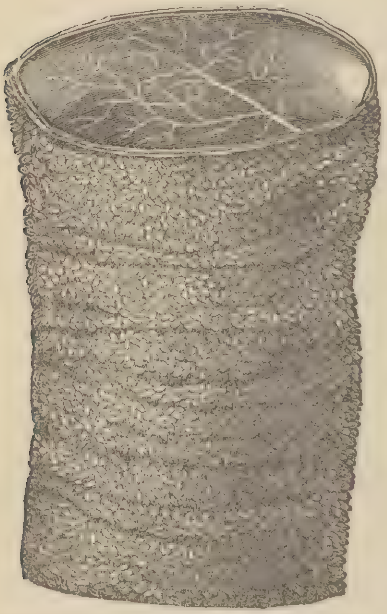
glands, where it is changed or manufactured into something more like blood, and then it passes into a much larger hall, called the thoracic duct, up which it goes to the left side of the neck, where it enters a pipe known as the jugular vein, which is carrying blood to the heart.

The mesentery is a broad thin membrane, upon one edge of which the small intestines are attached. The other edge is gathered up in a space about six inches in length and fastened to the spine in the region known as the "small of the back." By this arrangement the intestines, while left loose, are also kept from becoming tangled with each other.

Have you ever wondered how the food you ate got into your blood, and became blood in its turn? for you all know that if the food did not become blood it would do you no good to eat. [13] And now you can follow a mouthful of food on its journey, and see just what will happen to it on the way. You can see the teeth grinding it up fine, the saliva making the starch over into sugar, the stomach churning it, while gastric juice dissolves and softens and breaks up a part, and digests another part. Then you follow it into the *duodenum*, and watch the effect of the action of pancreatic juice and bile, and then, passing along into the small intestines, you see the work of digestion completed by the intestinal juice, and the milky chyle sucked up by the benevolent villi, who pass it along until it reaches the blood, and, mingling with it, becomes food for all the various parts of the body.

I have said that the food passed along through the

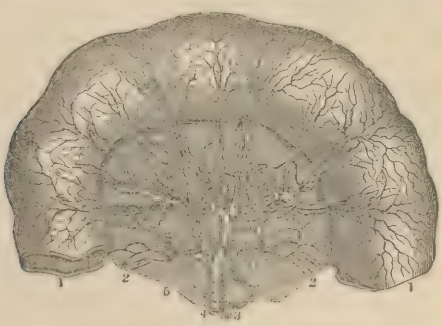
intestines as if it were alive and could walk; [14] but in reality the food is moved along by the action of the walls of the intestines, which draw together in some one place and then pull themselves back over the contents, which are thus pushed forward a little ways; then the walls immediately behind the contents contract and pull back, and thus they keep pushing the food along. [15] This motion, which is called peristaltic action, is never felt when we are in health, but [16] sometimes when we have eaten something that is not good for us the intestines are in a hurry to push it along, and contract so irregularly and so fast and with so much force that pain is caused.



SECTION OF THE ILEUM, TURNED INSIDE-OUT.

After dinner, the next thing always is to clear the table, pick up the fragments that are suitable to be eaten, and throw away the waste pieces. The servants, who eat after the family, dispose of many of the frag-

ments, and that which is not fit to be eaten is thrown into the scavenger-box. In the House Beautiful there is no extravagance or wastefulness ; we would therefore expect to find some way provided to use up that which has been left by the villi. And we do find that such provision has been made. [17] At the lower end of the dining-room a little trap-door, which has the name of the *ileo-cæcal valve*, leads into [18] a room, broader and shorter than the dining-room, which is

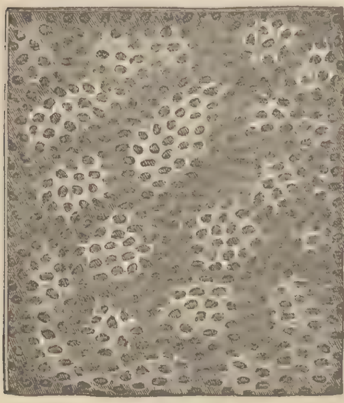


LACTEALS OF JEJUNUM AND MESENTERY.

1. Section of the jejunum. 2. Section of the mesentery. 3. Branch of the superior mesenteric artery. 4. Branch of the superior mesenteric vein. 5. Mesenteric glands receiving the lymphatics of the intestines.

known as the Colon. [19] Along the walls of this room are little folks called Absorbents, who pick out of the contents of the Colon that which is eatable, and the waste is left to be thrown into the scavenger-box or rectum, which, like all scavenger-boxes, should be emptied every day. [20] We have now followed the food in its journeyings, and have found that part of it is cast out as waste, but that the greater part is

used in building us up, in making us grow, or in keeping us in repair; and did you ever think how kind our Heavenly Father is in giving us such delicious things to eat, so that the duty of eating in order that we may live is made a pleasure to us? So great a pleasure, in fact, that we sometimes almost think that we live in order that we may eat, and so allow ourselves to eat things that are hurtful, just because they taste good, or we eat more than we really need, and so give our faithful household servants more work to do than they are able to perform.



ABSORBENTS OF THE COLON.

There is one truth we should all remember. [21] It is not the great amount of food we eat that nourishes us, but the amount we really use. If we eat more than the cooks can properly prepare, or than the villi and absorbents can take up and use, we have done ourselves an injury. Let us take this as our motto:

"I eat that I may live."

CHAPTER XI.

THE ENGINE.

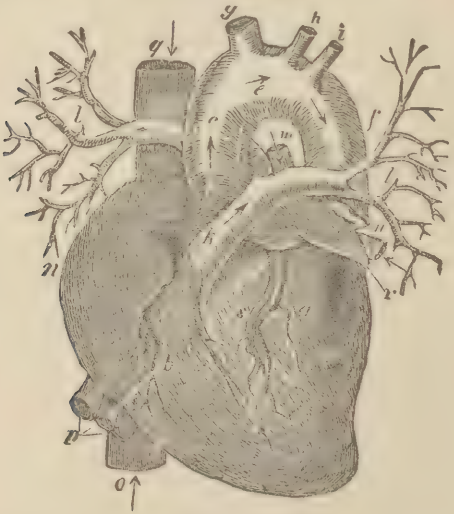
THE House Beautiful possesses a wonderful engine, which never rests from the time the house is first occupied until the tenant moves out forever. And that is one way in which this house differs from all others. [1] It never has but one tenant, no matter how long it may stand. [2] As soon as that tenant moves out, the house goes into decay, [3] and by watching the engine one can always tell whether the tenant has moved out. If he has only gone out for a short time the engine keeps at work; but if he stays too long, the engine stops, and then the house will never be inhabited again.

[4] The House Beautiful when first made is very small, but, unlike all other houses, it grows bigger and bigger for about twenty years, when it stops growing larger, but grows stronger and more solid (that is, if it is properly taken care of) for ten years longer.

Then it simply keeps itself in repair for a number of years, after which it begins to grow a little weaker year by year, until at last it is so much out of repair that the inhabitant moves away, and leaves it to decay.

[5] In very new houses the engine pumps very fast. [6] When about one year old it will make about one

hundred and thirty strokes in a minute, but as it grows older it is not in quite so much of a hurry [7] When three years old it will make nearly one hundred strokes in a minute. [8] In a house that is thirty



The Heart.

An external view of the heart. *a*. Left ventricle. *b*. Right ventricle. *c*, *e*, *f*. Aorta arising from the left ventricle. *g*. Arteria innominata. *h*. Left subclavian artery. *i*. Left carotid. *k*. Pulmonary artery. *l*, *l*. Its right and left branches. *m*, *m*. Veins of the lungs. *n*. Right auricle. *o*. Ascending cava. *q*. Descending cava. *r*. Left auricle. *s*. Left coronary artery. *P*. Portal veins, which return the blood from the liver and bowels.

years old the engine will make about seventy-five strokes in a minute, and it keeps getting slower until at eighty it will scarcely make more than one stroke to every second. [9] If it varies greatly from this, we know that something is wrong. Sometimes the

engine gets very excited, and pounds away so fast that it may be almost impossible to count it; then we generally say there is fever. If it beats much slower than it should, we then use some big words, and say, "There is great depression of the vital forces," and try to imagine that we have explained the matter very clearly.

Everybody appreciates the importance of this wonderful engine, which we call the [10] heart, and the necessity of keeping it running smoothly, although there are many who do not know just where it is located, or do not understand its construction.

"Oh, we all know where our heart is!" Do you? Well, then, of course you can tell me just where it is.

"Why, yes, of course we can. It is on our left side."

"Aha! I thought you did not know. It is not on your left side."

"I should like to know where it is, then; for I can feel mine beating on my left side, and when public speakers refer to the heart they always place the hand on the left side." So they do, and in so doing they place the hand just where the point of the heart touches the left side, but the bulk of the heart lies higher up, and more nearly in the centre of the body. If you put your chin down as low upon your breast as you can, it will touch a point over the heart.

Those of you who have ever seen the heart of an animal will have a good idea of the shape of the human heart. It is a good deal bigger at one end than at the other. [12] All kindergarten children will under

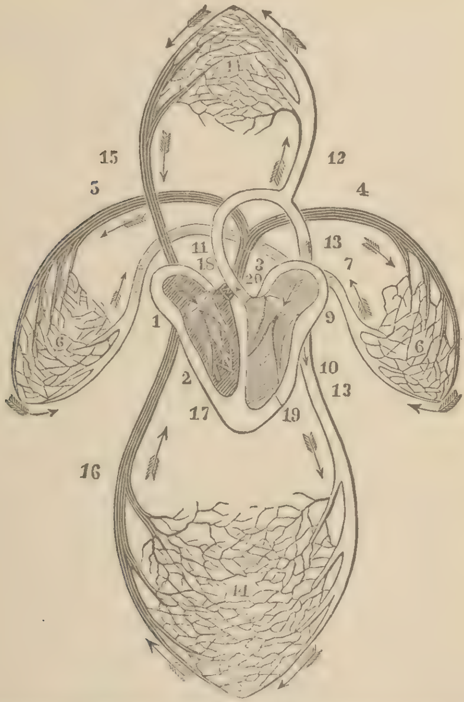
stand me if I say it is irregularly conical, and [11] lies with the base upward, about the point where the chin touches the breast, and the apex downward, touching the left side between the fifth and sixth ribs. About one-third of the heart lies at the right of a line drawn through the centre of the breast-bone. Thus you will see that the heart lies obliquely across the chest, reaching from the second rib on the right side to between the fifth and sixth ribs on the left.

The base or upper end of the heart is held in place by the larger blood-vessels which lead out of it, and the lower and smaller end is left free. The whole heart is enclosed in a bag or sac called the *pericardium*, which is a serous membrane. Serous membranes form closed sacs wherever there are parts which would rub against each other. They are made soft and slippery by a fluid which prevents friction.

Now that we have learned the location of our engine, we will study its construction. It seems quite a simple affair as we examine it, yet in its workings it is more wonderful than any other engine that was ever made.

[13] It is first divided by a partition lengthwise into a right and left side, or, as we sometimes say, a right and left heart. [14] Each side is then divided into two rooms, one apparently much bigger than the other. The smaller rooms lie above the larger ones, and are therefore at the base of the heart. [15] They are called respectively the right and left auricles, or ears, because they have something the shape of the

ear of an animal. [16] The larger rooms are the right and left ventricles.



DIAGRAMATIC REPRESENTATION OF THE CIRCULATION OF THE BLOOD.

1. Right auricle. 2. Right ventricle. 4 and 5. Venous blood going to the lungs 6. Capillaries of lungs. 12. Arterial blood going to upper part of body. 13. Arterial blood going to lower extremities. 14. Capillary circulation between arteries and veins. 15. Venous blood returning from upper part of body. 16. Venous blood returning from lower extremities.

Though the construction of both sides of the heart is alike they have each a different work to do, dif-

ferent in degree but not in manner. [18] The right heart deals only with impure and soiled blood, the [19] left heart only with pure or cleansed blood.

[20] A large pipe, or tube, called the descending *vena cava*, brings the soiled blood from the upper part of the body to the right auricle, and another one, called [21] the ascending *vena cava*, brings it from the lower part of the body to the same place.

[23] When the auricle is full, its walls squeeze together and press the blood into the ventricle. [24] There are folding-doors between these two rooms, and they are made so as not to let the blood flow back into the auricle. Have you ever seen a gate with one end of a rope fastened to it and the other end to a post so that the gate will go shut but never swing open the wrong way? [25] In the same manner these folding-doors are tied to the walls of the ventricle so that they can never swing back into the auricle. When the ventricle is full, its walls contract, and the blood presses against the doors or [24] valves until they are shut, and then as the strings hold them fast so that they can not swing back, the blood is compelled to go out into a tube called the pulmonary artery, which [26] carries it away to the laundry to be washed.

[27] There are also valves at the entrance to this artery, which will not allow the blood to return into the ventricle. They are called semi-lunar valves, because they are the shape of a half-moon.

In like manner the pure blood, which is brought from the laundry, through pipes called pulmonary veins, [29] into the left auricle, is sent from there into

the left ventricle, [30] and from there into a great big tube called the *aorta*, [31] from whence it is distributed throughout the body to give up its nourishment, to receive waste, and to return again through the *venæ cavæ* to the right heart. [32] There are only two doors between the left auricle and ventricle. They are called bi-cuspid (two-pointed), or [34] mitral, because they are supposed to resemble the mitre or two-pointed cap worn by a bishop; [33] while between the right auricle and ventricle there are three doors which are therefore called the three-pointed or tri-cuspid valves. [35] The walls of the left ventricle are much thicker and stronger than those of the right, because it has to send the blood a much greater distance. Thus you will see that there are two circulations of blood from the heart, the right ventricle sends the blood to the lungs, whence it returns, after being washed, to the left ventricle, which sends the blood through the whole body.

[36] It is estimated that each ventricle in a grown person will hold about three ounces of blood, and as each ventricle fills at every stroke of the heart, it follows that six ounces of blood will be pumped out of the heart at every stroke. [37] We learned that the heart of a man beats about seventy-five times in one minute. [38] How often will it beat in an hour? [39] Multiply seventy-five by sixty, and you have four thousand five hundred strokes in an hour, and in a day it will beat [40] one hundred and eight thousand times. [41] Six ounces at each stroke would be six hundred and forty-eight thousand ounces. And that is more than

twenty tons. Would you believe it possible that a man's heart does as much work as that in twenty-four hours?

"And does it never rest?"

[42] Yes, it rests between beats. Just think; only those tiny resting spells from the time we are born until we die. [43] It rests most at night, because we are quiet and lying down. As soon as we sit or stand up it begins to beat faster, and you know how it will pound away after you have been running rapidly. Moderate exercise never does a well person harm. But when great physical effort is put forth continually, as by men who are engaged in walking-matches, or rowing-races, or such contests, this great [44] demand upon the heart causes it to hypertrophy (that is, to grow larger), and before many years it becomes weaker, and the man does not walk or row as he once did, and at last he fails in health entirely; and it is all because his heart has been overtaxed in years past, and has lost power. Let us, then, remember that the engine can not rest like most parts of the House Beautiful, and respect its wishes by not giving it too much to do in too short a time.

CHAPTER XII.

THE HOUSEKEEPER.

"For a housekeeper has always such a world of things to do."

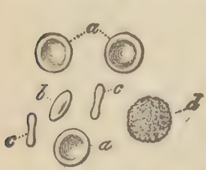
If you have never been a housekeeper, you nevertheless have had an opportunity to see how busy housekeepers always are. [1] They must see that every member of the family is provided with appropriate food and clothes; that the whole house is kept clean and in order; and that all refuse is quickly removed. They must keep their eyes open to observe where any repairing needs to be done, and see that it is done. The Housekeeper in our House Beautiful is no less busy looking after every department. But, strange to say, she does not decide what repairs need to be made; and, stranger still, the owner of the house does not decide that question; in fact, he couldn't if he would; and, strangest thing of all, [2] each part of the house knows how to repair itself. [3] It selects the material which it needs, and receives it from the Housekeeper, if she has it, and [4] gives to her the worn-out pieces which she takes along with her.

[5] Blood, the Housekeeper, starts out from the left heart, in a bright scarlet dress, on her round of duty through the house. [6] This bright color of her dress is made up of innumerable little parcels, called [7] the

red corpuscles, which have come from the lungs loaded with oxygen which they are going to carry to every part of the house. [8] These corpuscles are round like pieces of money, only they are thinner in the centre than at the edges, and might be more truly compared to a rubber ball pressed together on two opposite sides. [9] They are so small, that three thousand five hundred of them, lying side by side, would make a row only an inch long. [10] But, besides the red corpuscles, Blood carries with her little white globules, called white corpuscles. [11] These are not quite as small as the red ones, and there are not nearly so many of them, one white to about five hundred red. [12] These little red and white corpuscles float along in a fluid called the serum, which is largely made up of water, and which contains in solution all the material for building up the body, such as albumen, soda, potassium, magnesia, iron, and many other substances.

RED CORPUSCLES.

A represents the blood-corpuscles as seen on their flat surface and edge. B. Congeries of blood corpuscles in columns. In coagulating, the corpuscles apply themselves to each other, so as to resemble piles of money.



CELLS OF HUMAN BLOOD.

[13] We will imagine the Housekeeper, loaded with her myriad of little bundles, starting out from the left heart through the big hall, or tube, the aorta. [14] A pair of doors, called semi-lunar valves,

close behind her, and she hurries along, very rapidly at first, because the engine has sent her out with great force. [15] From this large passageway smaller ones begin to branch off, and she rushes through some up to the head, and through others to the arms, and through others to the stomach and all the internal organs, and down even to the ends of the toes, through many halls which grow smaller as they become more numerous, just as the branches of a tree get smaller and smaller as they divide and subdivide until they end in tiny twigs. [16] These halls are known as arteries, and they have stiff walls which make them keep their shape, but the walls are also elastic and will stretch, so that sometimes they can contain more blood than they do at others. The blood is not allowed to stop anywhere on the way, for the engine keeps on pumping and sending it along. [17] You can feel how it goes in waves through the arteries if you put your finger over one where it comes near the surface, as on your temple, or on the thumb side of your wrist.

After a time the halls become so very narrow that the little red corpuscles can only squeeze through one at a time. [18] The halls are then called capillaries, and form a network as in the lungs. [19] It is here in the capillaries that Blood leaves her bright scarlet dress and puts on a purplish one. [20] She has given up oxygen to keep you alive, and now, with dress soiled by carbonic acid gas and various refuse received into the blood from the tissues, she begins her return journey to the heart. She [21] leaves the capillaries by a num-

ber of small hallways which merge in large ones, just as the rootlets of a tree are merged in the larger roots, and they at length in the trunk. [22] If Blood is com ing from the feet she reaches the engine through the large vein, the *vena cava ascendens;* if from [23] the upper part of the body, through the *vena cava descendens.* [24] The veins differ from the arteries in their structure. If a vein is cut across, its walls do not stand open, as do those of the arteries, but they will fall together. [25] Then the veins communicate with each other everywhere by little branches which pass from vein to vein, thus making the veins more like a network. In the arteries this takes place occasionally, but is the exception rather than the rule. [26] The veins of the surface of the body are provided with valves which prevent the blood flowing backward. The arteries do not need valves, because they lead from the heart, and the force of the heart's action sends the blood along; but in the veins this impulse is not so strongly felt, and, besides that, the blood from the lower extremities has to climb up-hill, and the valves tend to prevent it slipping down again. [27] You can see how hard it is for the blood to climb up if you hold one hand hanging down. It will get very red, and the veins will show full of blood. Now, if you hold it over your head, it will soon get white again, because the blood has found it easy to run down-hill.

[28] Through the veins the blood runs in a steady stream, but through the arteries it goes in jets, or spurts. [29] The remembrance of this fact is useful in accidents, for to cut an artery is much more serious

than to cut a vein, and we can judge which has been cut by the way the blood flows out. [30] The arteries come direct from the heart, and if one is severed it could soon empty the whole system of blood; but a cut vein would have to empty all the capillaries before it could carry off all the blood, and the capillaries are so numerous that they contain more than [31] five hundred times as much blood as the arteries. [32] The entire amount of blood is estimated to be about one-eighth of the body, so that in a man weighing one hundred and forty-four pounds the blood would be about eighteen pounds.

[33] How long does it take this amount of blood to pass through the heart? Many calculations have been made and experiments tried, and it is thought that the whole amount of blood passes through the heart every forty-eight seconds, or nearly one minute. [34] Of course the blood travels faster in the arteries than in the capillaries or veins, and faster near the heart than at a distance from it. [35] In the large arteries near the heart it is estimated to move at the rate of ten or twelve inches every second, while in the [36] arteries of the foot it moves only two and a quarter inches in a second, and in the capillaries at the rate of about one inch in a minute.

If you could see the blood corpuscles moving through these narrow halls you would find much to interest you. They seem to know so well what they are about. [37] Sometimes they will all go in one direction for a while, then suddenly they will turn and all go the other way. Sometimes two rows meet at a

point where the narrow halls unite to form a larger one, yet not large enough to admit more than one corpuscle at a time, but there is no crowding and jostling. [38] One row politely waits until the other row has passed in, then they will follow in their turn. [39] Capillaries exist everywhere in the body, on the surface, and in all the internal organs. You can form an idea of how close together and how small they are by seeing a person blush. [40] The capillaries on the surface have suddenly dilated from a mental emotion, and the blood has rushed into them in such great quantities that they become visible, but not as red lines crossing each other, with white spaces between, but in one uniform flush. If you prick yourself with the finest needle you pierce a capillary, and a drop of blood oozes out. [41] So that the spaces between the network of capillaries must be much smaller than a needle-point. And that reminds me of a peculiar disposition our Housekeeper has, to run away whenever she has a chance. [42] Let ever so little a door be opened and out she pops, and she runs until something stops her. [43] And what does stop her? If it is from a cut finger she is running, and you go to mamma, and she ties the finger up with a cloth, you probably think that mamma stopped her. Or if it were from a severe wound, where an artery was cut, and a doctor was called to stanch the blood, you no doubt thought that the doctor stopped her; but you were mistaken; she stopped herself. All the mammas and doctors in the world would have been of no avail if she had not possessed in herself the ability to prevent herself from running further.

[44] Blood carries with her a substance called fibrin, that is usually dissolved in the blood, and is a food. So long as Blood stays in the blood-vessels fibrin does not interfere with her, but goes quietly where she goes. But so soon as she escapes from the house and begins to run away, fibrin tangles around her feet and holds her. [45] This is what is called *coagulating*, or forming a clot, and this clot acts as a cork, and stops up the place from which the blood is flowing. [46] If there were no fibrin in the blood all the bandages that mammas or doctors could apply would not stop the bleeding; but because there is fibrin there, the bleeding often stops if nothing is done.

[47] It is in the capillaries that nutrition of organs takes place. Here the red blood corpuscles give up their oxygen and take up carbonic acid. [48] Here, in some mysterious way, the different foods needed by the various organs pass out of the blood into the tissues, and the waste material is taken into the blood: by *osmosis*, we say. Yet this does not clearly explain it, for if it were merely osmosis, why will certain substances held in the blood in solution pass through at one point and certain others at other points? [49] Here a nerve says, "I need a little phosphorus," and the phosphorus leaves the blood and goes to the nerve, and the worn-out nerve particles are passed into the capillaries. [50] Here a bone says, "I need lime and soda"; a muscle says, [51] "I need albumen"; the hair says, [52] "I must have iron"; and the nails say, [53] "Give me silica"; and each one gets just what he needs, and nothing else. I said, "Gets just what he needs," but

he [64] can't get it if it is not in the blood, and sometimes the bones do not get what they need, and they get soft and weak and bend easily, and the person perhaps becomes deformed, has bow-legs or a crooked spine; or the nerves fail to find their food; or the muscles theirs, and then there is trouble all over the house, and we say, "It is sick."

[65] The Great Architect has provided everything needful to keep the house in perfect repair, if we only have the wisdom to select the foods which contain it. [66] The various animals given us for food; the grains which make golden our field in autumn, the fruits which hang in luscious clusters from vine and tree, each and all contain the various elements of which our wonderful dwelling is made. Ought we not daily to thank Him, and to live so that our House Beautiful may in truth be a fit temple for the indwelling of His Holy Spirit?

CHAPTER XIII.

THE LAUNDRY.

[1] THE washerwoman of our beautiful house is a very important and aristocratic personage, and has a special entrance for herself.

She has also a very pretty name, *Aura*.

"I know who that is. *Aura* is a Latin word meaning air."

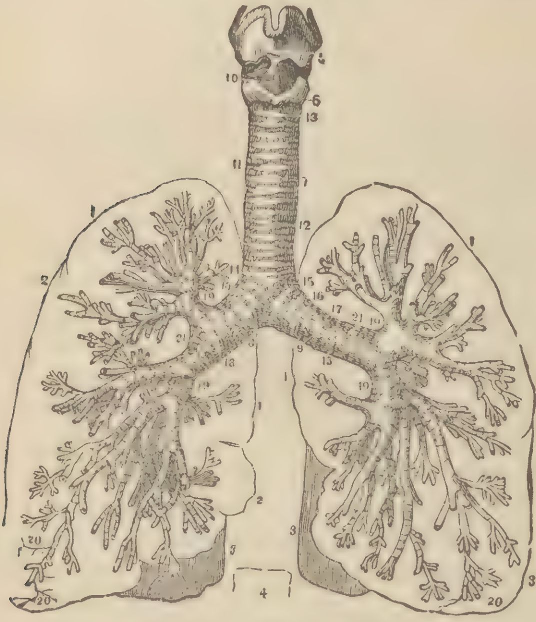
Yes. And [2] here she comes, all sweet and pure and bright, and she enters at the two round openings under the portico, called nostrils, and climbs a winding stairway, up and back, [3] and if she is cold this warms her somewhat, [4] and if any foreigners, such as particles of dust, are trying to enter with her, they are kept out by guardsmen stationed there.

She now enters the same chamber from which the kitchen stairs descend, but she is not going into the kitchen.

[5] She crosses the head of the kitchen stairs, and a little trap-door discloses another stairway, down which Aura hastens into the laundry. [6] This stairway is called the trachea, or windpipe, and is made of about sixteen rings of [7] cartilage or gristle, which are firm enough to keep the passageway always open. [8] Passing into the chest, the trachea divides,

and we have two stairways, [9] leading, one into the right, the other into the left division of the laundry.

[10] These are called the bronchial tubes, and they in their turn divide and subdivide until they become



TRACHEA AND BRONCHIAL TUBES.

6. Bifurcation of trachea into right and left bronchial tubes, which divide and subdivide like the branches of a tree. 9, 12. Trachea. 10. Larynx.

very minute, and each one terminates in a [11] tiny little tub called an air-cell, one two-hundredth of an inch in diameter, as we say, [12] meaning that two hundred of them would make a row an inch long. [13] There

are six hundred millions of these tiny tubs, and that is more than you or I, or any one else can comprehend.

[14] The walls of these air-cells are so thin that ten

THE AIR-CELLS, OR THE STATIONARY TUBS OF THE LAUNDRY.

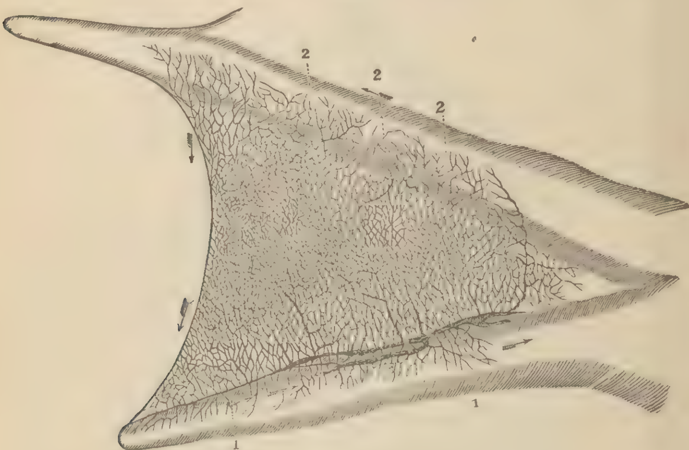
1. A bronchial tube. 2, 2, 2. Air-cells or vesicles. 3, 4. A bronchial tube and vesicles laid open.

of them would hardly make the thickness of a sheet of writing-paper, but they are very tough and strong.

[15] If you could spread this thin membrane out over a flat surface, it would, if Professor Lindenau is correct, be enough to cover ten or twelve rooms as large as your mamma's parlor, if that is fifteen feet one way and sixteen feet the other.

You have already [16] learned how the blood is carried from the right heart to the lungs, which are the laundry, through the pulmonary artery, which, on reaching the lungs, divides, and divides again and again until the little tubes are [17] so small that three thousand of them could lie side by side in a space an inch wide, [18] and so beautifully are they interwoven that if looked at through a microscope they resemble delicate lacework. [19] These wondrously small blood-vessels are called capillaries (a word meaning hairs),

[20] and they encircle the outside of every little air-cell, or tub, [21] and are filled with the soiled blood which has come to the laundry to be washed. "But the blood is a liquid; how can it be washed?" Ah! this



THE CAPILLARY SYSTEM.

Representing the anastomoses of the blood-vessels which form the capillaries, as seen in the web of a frog's foot by the aid of the microscope. 1, 1. The veins. 2, 2, 2. The arteries.

washing of the blood is truly wonderful, but I hope to explain it so that you may clearly understand it. [22] The laundry consists of two large rooms located in a part of the House Beautiful called the thorax or chest. [23] These rooms are elastic. [24] The thorax has a floor called the diaphragm. It is not a level floor, but curves upwards so that on the upper side it is convex, and on the under side concave.

[25] You will be able to understand that this makes

the cavity of the thorax smaller than if the diaphragm went straight across. [26] The bony walls of the thorax are the spine in the back; the *sternum*, or breast-bone, in front, and the ribs on the sides. [27] These bony walls are covered with muscular walls, and when we breathe in the air these muscular walls contract and raise the ribs, and the diaphragm descends in the middle, becoming more nearly level, and thus room is made for the lungs to grow larger. [28] When we breathe the air out, we just let go, as it were, and, like a rubber ring that has been stretched, the ribs fall back to their places, the diaphragm rises to its place, the air is sent out, and the lungs are ready to be filled again. [29] Breathing in, is *inspiration*, and as it requires effort, is called active; breathing out, is *expiration*, and as it requires no effort, is called passive. [30] Both together are *respiration*. We sometimes say of persons that they have expired; that means that they have breathed the air out of their lungs, never to breathe it in again.

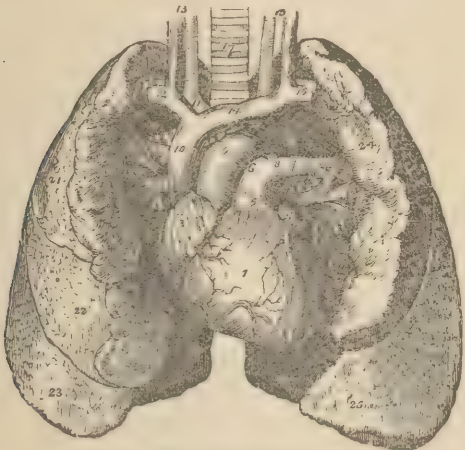
[31] And now I will tell you a secret that many of our wise physiologists have not yet found out. They say that men breathe differently from women; that in men the lower end of the sternum moves forward farther, the diaphragm descends lower and becomes more nearly straight, and the walls of the abdomen are pushed forward, and thus rise and fall with each breath; while in women the sternum and diaphragm are less movable, and therefore the upper part of the chest heaves with the breathing. And they say, [32] "Thus we have two types of breathing, the abdomi-

nal or masculine, and the thoracic or feminine." Now comes my secret. [33] If you should dress a man tightly about the waist as women dress, his sternum and diaphragm would not be movable either, and in order to breathe at all he would be obliged to adopt the feminine type. Good teachers of music and elocution all say that their lady pupils nearly always have to be taught how to breathe with the abdominal muscles before they can have good control of their voices. [35] All babies know how to breathe, and I think it would be wise for all girls and women, in this respect, to remain as little children.

[36] When Aura entered the nostrils she came with alacrity, partly because she had received an urgent invitation, and partly because it is her nature to rush into every place that is opened or left open. [37] She is always busy trying to do good by cleaning up everybody and everything. Many washerwomen have a washing fluid which they consider a very great assistance in removing the dirt from clothing. [38] Aura, too, has something, but it is neither fluid nor crystal, it is a gas, with which she not only removes dirt and impurities from the blood, but she also uses it as a food with which to build up the tissues. It is called oxygen.

When the thorax is enlarged Aura rushes in to fill the laundry, and takes with her oxygen as a part of herself. [39] She fills every air-cell, and at once receives from the blood the carbonic acid gas which made it dark-colored and sluggish, [40] and in turn gives to the blood the oxygen, which [41] makes the blood a bright

scarlet color and endues it with new life-giving properties with which to repair the body. But a most wonderful change has taken place in Aura. [42] She came in your friend; she is sent back up the dark, winding



HEART AND LUNGS.

The anterior aspect of the anatomy of the heart and lungs. 1. Right ventricle; the vessels to the left of the number are the middle coronary artery and veins. 2. Left ventricle. 3. Right auricle. 4. Left auricle. 5. Pulmonary artery. 6. Right pulmonary artery. 7. Left pulmonary artery. 8. Remains of the ductus arteriosus. 9. Aortic arch. 10. Superior cava. 11. Arteria innominata: in front of it is the right vena innominata. 12. Right subclavian vein; behind it is its corresponding artery. 13. Right common carotid artery and vein. 14. Left vena innominata. 15. Left carotid artery and vein. 16. Left subclavian artery and vein. 17. Trachea. 18. Right bronchus. 19. Left bronchus. 20, 20. Pulmonary veins; 18, 20, from the root of the right lung; and 7, 19, 20, the root of the left. 21. Upper lobe of right lung. 22. Its middle lobe. 23. Its inferior lobe. 24. Superior lobe of left lung. 25. Its lower lobe.

stairway, no longer sweet and pure, but soiled and unclean in dress, and even deadly in her intentions. [43] Should you invite her immediately to return, she

will accept your invitation, but she does it as your enemy, only to strike at your very life. [44] But let her go away for a time and shake her garments in the wind, and sun them in the light of heaven, and she is again your friend.

But how does the oxygen get into the blood, and the carbonic acid gas get out, when there is always a thin membrane between the blood in the capillaries and Aura in the air-cells? It is by *osmosis*. [45] If you should fill a tumbler with milk, and tie over the top of it a fresh bladder, so tightly that the milk could not run out, and should then immerse it in a dish of water, you would find that the milk became watery, and the water milky; showing that milk had passed through the bladder into the water, and water had passed into the milk. This is called *osmosis*, or the passage of fluids through animal membrane. [46] And this is what takes place in the lungs, only it is gases that pass in and out instead of fluids. It is, then, by osmosis that the blood is washed.

This, then, is what Aura has to do: carry oxygen into the lungs and bring out carbonic acid; [47] and she goes in and out about twenty times in a minute, in a person between fifteen and twenty years of age. Not so often when we are asleep; a little less frequently as we grow older, but more frequently when we are younger. It is well enough to remember that every time we breathe, the heart beats about four times.

Why do we breathe? "To carry air into the lungs." That is true; but that is not all the truth.

[48] We breathe air into the lungs so that we may get oxygen into the blood. [49] Oxygen is the most important food of the body. It is estimated that one-half of the body is made up of oxygen, so that there is a constant demand for it. [50] We can not feed the lungs two or three times a day, as we can the stomach; the supply must be constant. We often think, when we are hungry, [51] that it is the stomach that is asking for food, but in reality it is every part of the body that is saying, "I'm hungry." So with thirst. It is not merely the mouth and throat that want water; [52] it is the blood and all the tissues that cry out, "We are thirsty." And when we feel suffocated, and gasp for breath, it is a cry of the whole body for oxygen. [53] Sighing, from whatever cause, is evidence of lack of oxygen in the blood; the same is true of yawning.

[54] You must not think that the lungs are filled and emptied at every breath, for it is not so. But before I say more on this point I must talk to you a little about cubic inches. Now, don't pout and say, "I don't like figures, they are not interesting," for you may be mistaken; and you ought to learn about cubic inches, for that is the way volume is measured. [55] Do you know what a cube is? Baby's letter blocks are cubes. If you examine them you find that each one has six equal sides, and all its angles are right angles. If each side is an inch square the whole block would be a cubic inch. [56] A pint cup holds about thirty cubic inches, and [57] that is nearly the amount of air that, in a grown person, goes in and out with every breath. [58] This we call tidal air. [59] But if we try, we can take

in more air—about one hundred cubic inches. This is called complemental air; and be sure you spell it with an *e*, and not an *i*. If we [60] make an effort we can breathe out more than the pint of tidal air—about one hundred cubic inches—which we call reserve air, for we have it in reserve to use when we run or work hard. [61] But there is a like amount which we can not breathe out, which is called residual air, [62] so that you see the whole capacity of the lungs is about eight pints, and this we call the vital capacity; that is, our ability to live. But if only one-eighth of the air in the lungs goes in and out constantly, how can the blood get oxygen and give up its carbonic acid gas? You will understand this when I tell you that the Gas family have a very familiar way of associating with each other. [63] If you fill a cup full of water you can not put in another cup full of water or milk without making it run over; but that is not the case with the Gas family. You could fill the cup with oxygen, and then with hydrogen, and then with nitrogen, and the cup would not run over. Each would fill it full, and yet all of them together would fill it no more than full. [64] This is called the diffusion of gases, and it is because they mix with each other in this way that oxygen circulates throughout the lower parts of the lungs.

[65] There are millions of active little fellows called Cilia, which are like little short hairs growing all along, and standing out from the bronchial tubes, who assist in this work. [66] They are always in motion, lashing the air and driving it from within outward,

and thus aid in distributing the gases upon which the aeration of the blood depends.

What a fine thing it is that all this wonderful process of cleansing the blood and providing oxygen for the tissues is not dependent upon our thought! Night and day we breathe without thinking about it. [67] Yet we ought to think about it enough to provide ourselves with as pure air as possible; to give our lungs plenty of room to work; and to use the proper muscles in breathing.

[68] We should never forget that oxygen is food for the blood and tissues, and should be as free from poison as any other food of the body. We should let Aura come freely into our living and sleeping rooms to cleanse them of all impurities, [69] but we should be careful that she does not take into the lungs with her any such poisons as tobacco; for smoke is even more hurtful to the delicate structures of the lungs than to the eye, and we would never put tobacco smoke into our eyes.

[70] The pollution of wells, rivers, and lakes is punishable by law, and we have an equal right to demand that the air we breathe shall also be free from pollution. It is more than rudeness, it is morally wrong; and is it not even a crime for tobacco-smokers to poison the air which their neighbors must breathe? We should insist upon it as far as possible that Aura should enter the laundry of our House Beautiful, as pure and sweet as God has made her. [71] We should also insist upon it, by night and day, that she should enter and depart by the door which has been provided

for her, and never by the pink folding-doors, unless in a great emergency. There is one very curious thing about her coming in at night. [72] If, while we are asleep, the folding-doors drop apart, she creeps in through them, not quietly, like a thief in the night, but with a queer noise, a gurgling, rasping, and blowing sound, as if she were trying to waken us up to shut the door. This is what we call snoring, and is not only an unpleasant but an unhealthful habit. [73] Be sure to shut the folding-doors tightly when you go to bed, and keep them shut. And to do this you must keep them shut during the day when not obliged to open them. [74] It gives a very foolish expression to the face, to go with the mouth open. If you wish to look and feel brave and courageous, close your lips firmly together. If you wish to keep dust and germs of disease out of your lungs, keep your mouth shut when you breathe. [75] If you wish to have a clear, sweet voice; to avoid colds; to look as if you knew something; to avoid sore throats and coughs; in short, if you wish to be healthy, wealthy, and wise, shut your mouth and open your eyes.

CHAPTER XIV.

THE FURNACE.

I HAVE just been calling on a lady who sat in a cheerful room by an open coal fire, which glowed so brilliantly in the grate that it made me happy just to look at it. When I spoke admiringly of the fire and said I wondered that it kept the room so warm, the lady replied:

"Oh, we do not depend altogether on this fire for heat. We have a furnace in the cellar, and a stove in the hall besides."

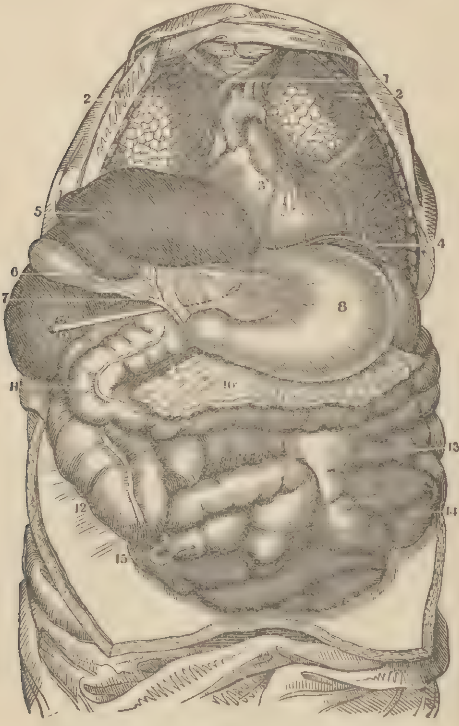
I have been thinking how our House Beautiful is warmed, and I am reminded of the lady's pleasant home, and how much, in their heating apparatus, the two are alike, neither depending solely upon one means of generating heat. If you please, we will first pay a visit to our Furnace.

[1] We find it located on the right side, below the Laundry, and even below the floor called the diaphragm. In fact, it hangs from this floor, fastened to it by ligaments, and so is to some extent movable. [2] This Furnace is known as the liver, and the Physiology says it is the "largest gland in the body."

"But what is a gland?"

That is right. You must always stop me when I say something you do not understand.

[3] Glands are organs of the body in which something is manufactured from the blood as it passes through



THE LIVER IN CONNECTION WITH OTHER ORGANS.

2 Lungs. 3. Heart. 5. Liver. 6. Gall-bladder. 8. Stomach. 12. Colon. 13. Small intestines.

them. The salivary glands manufacture Saliva, one of the assistants in digestion. [4] The liver is a gland, and manufactures Bile. It also makes sugar; and

where so much manufacturing is going on, there must of necessity be a fire. [5] We can not see the fire, but it has been proven that the blood coming from the liver is warmer than that going to it, so it certainly was warmed in passing through, and therefore we are justified in calling the liver a furnace, are we not? even if we can not tell just how it produces heat.

[6] As I said, it is the largest gland in the body, weighing from three to four pounds. You will remember that such statements are always made in regard to a grown person, and for children are proportionately less. [7] It is nearly a foot broad and half a foot thick. [8] It lies just behind the short, floating ribs, and sometimes when they are squeezed by a tight dress or corset [9] they press into the liver and make ruts in it, and then it complains, [10] sometimes by a pain in the side, sometimes by painting the outside of the house an ugly yellow color, and making the tongue rough, and leaving a bad taste in the mouth. Then people say they are [11] "bilious," and that always means that the liver is scolding about something.

There are many wonderful things about the liver that I shall leave you to find out when you grow older and study more; [12] but I will tell you that it is divided into two lobes, the right lobe being six times larger than the left, and divided from it by a deep fissure or crack.

[13] In a little niche in the right lobe there is nicely stowed away a little jug, that will hold about [14] eight

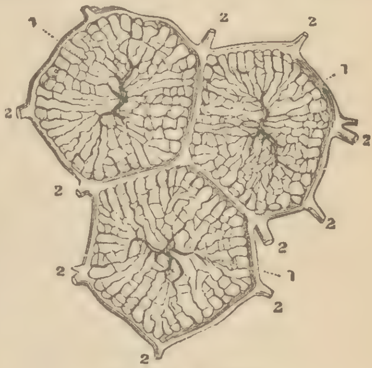
teaspoonfuls, and it is filled with the bitterest stuff imaginable, the bile or gall, and its name is the gall-bladder. Chickens have just such a little jug, and a cook is very careful not to spill any of its contents on the meat, for she knows it would not be eatable if flavored with gall. This is where Bile stays when not needed in the Butler's Pantry or in the Dining-room.

[15] I said the liver is divided into two lobes, but in reality there are various fissures which divide it into five lobes; and it has five ligaments which support it, and five arteries to bring the blood to it, and five veins to carry the blood away from it. That makes a quartette of quintettes, doesn't it? that is, four groups and five in a group.

Oh, dear! I seem to be all the time having to correct myself in this article. I said the arteries carried blood to the liver; and here a big vein, called Portal Vein, nudges me and says: [16] "I think you forgot that I carry blood to the liver, and I am not an artery, I am a vein." I am very glad he spoke just then, for that reminds me that I must tell you about this portal vein.

[17] When Blood leaves the heart, and starts to go down to the feet, she finds a great many passageways leading downward, but they do not all go to the toes. Some of them end in capillaries of the intestines, and from these the blood is gathered up in veins and carried, by this short cut, to the liver. This system of veins is called the portal system, and the many small veins are all merged in a large one, called the portal

vein. It is supposed that the blood receives from the capillaries of the intestines some impurities that ought to be gotten rid of as soon as possible, so they are sent at once to be burnt up in the furnace, or to be cast out through the bile duct into the intestines, and so eliminated from the system. [18] The portal vein divides many times in the liver, and together with minute branches of another vein and artery, and a duct called the hepatic duct, forms little round knots, which are termed lobules. [19] In and between these lobules are cells of the liver-substance. [20] The artery known as the hepatic artery (hepatic means belonging to the liver) brings the blood which nourishes the liver. [21] The hepatic duct is the tube which conveys the bile either to the butler's pantry, or, when not needed there, into the cystic duct, and thence to the gall-bladder, which seems to serve no other purpose than that of a jug, in which the bile is stored when not needed in digestion. [22] It is estimated that as much as two pounds of bile are made every day by the liver of an adult, that is, a grown person. [23] A part of this bile, you will remember, is used in preparing fat for digestion, and a part is probably waste



LOBULES OF LIVER.

material from the portal system. Another office of bile is to keep the food from spoiling, and also to make it slippery, so that it will be easily moved along through the intestines.

[24] Just how or where the bile is made, our wise men have not yet discovered; but it is probably made in those wee little cells in and between the lobules. [25] And in these same cells it is also supposed that the sugar is made. [26] What wonderful little live kettles they are! How is it possible that from the same blood they can make the bitter bile and the sweet sugar? It is more amazing than any fairy tale I ever read. [27] But they do it, and we have learned that they make the sugar out of the starch we eat, just as saliva changes the starch to sugar, you remember. And we have learned that they make sugar out of the albuminous foods; and, indeed, it would seem that some forms of albumen can not be used in the body unless changed into sugar by the liver.

[28] And all the sweet things which we eat have to be changed into liver-sugar before they can do the work they have to do; that is, be consumed to keep us warm. And if you think of this a moment, you will see why it is best not to eat too much candy. [29] The liver is all the time making sugar, and at the same time must make over the sweets which we eat into liver-sugar, or glycogen, and if we eat a great deal of candy, we give the furnace too much to do, and perhaps we kindle too big a fire and have what we call a bilious fever; though that does not always come from eating too much candy, it may come from many other causes.

It is supposed that this glycogen is consumed in the lungs, and helps to keep the house always at the same temperature. [30] And that is another astonishing fact, that, no matter how cold or how warm the weather, our House Beautiful always maintains an equable heat — about ninety-eight degrees F., that means by the thermometer invented by Fahrenheit. Some other thermometers do not measure that way, so we use the F. to indicate which one we mean. Ninety-eight degrees is pretty warm weather, we think, in summer, but we do not complain because our House Beautiful is so warm. Indeed, we are sick if it gets one or two degrees colder, and also if it gets one or two degrees warmer, while in our dwellings, or in the weather, we can endure great changes without injury.

[31] "But we get much warmer than ninety-eight degrees when we run fast, do we not?"

We feel much warmer, but in reality the thermometer would not show as great an increase of heat as we would suppose, for there are ways provided for cooling us off when we get too warm, of which we shall speak hereafter.

But this fact of getting warm when we run, shows us another way in which heat is made in the body. [32] When we exercise our muscles we use up muscular tissue faster than when we are idle, and the blood circulates more rapidly, bringing oxygen to build them up again, and this oxidation produces heat. [33] You will learn when you study chemistry that combustion is oxidation. When it proceeds slowly, as in iron, we call it rusting; and when it proceeds rapidly, as

with wood, we call it burning. Whether we can call it burning in the body might be questioned, so we will simply call it oxidation, and understand that it produces heat. And you will then comprehend why running and jumping make us warm.

[34] Breathing makes us warm too. We may not be able to tell how, but we know that heat must, to some extent, be manufactured in the lungs, or breathing would cool us off. [35] But instead of the cold air cooling us very much, we warm it in our lungs, and we stay at the same temperature. The ancients used to think that the whole use of the lungs was to cool us off; but we know better than that. Through them we are furnished with oxygen, and helped to keep warm. Cold-blooded animals, you know, breathe very little.

[36] So, you see, we have three modes of heating our house: by the furnace, by the laundry, and by motion. You might be astonished to know how fast motion will warm a muscle. [37] Sawing wood for five minutes raises the temperature of the biceps muscle in the arm two degrees. That would be a first-rate way for cold boys to get warm; and I have known a broom to do as much for a cold girl.

CHAPTER XV.

THE MYSTERIOUS CHAMBERS.

ALL houses, that are worth anything for a story, have a mysterious chamber,—often with a secret door, or with the entrance-way walled up so that no one can get in,—and every one wonders what strange, uncanny thing may be hidden therein. Our House Beautiful has several mysterious rooms. They are all open to inspection, to be sure; yet no one has ever been wise enough to find out just what is going on in them, though a great many people have made guesses at it.

[1] We have been told that secretion is making from the blood a new material that is not found in that form in the blood. Bile is a secretion; so is gastric juice, and all the other digestive fluids. [2] Excretion is separating from the blood something that already exists in it and which is not wanted in the system, as the carbonic acid gas.

Our wise men, puzzling over these mysterious chambers, have wondered whether they could be for the purpose of manufacturing something,—that is, secretion; or merely for getting rid of waste,—that is, excretion. [3] But all excretory organs have a tube, or duct, for carrying off the excretion, and these have none. [4] They are fitted up with all the arteries, capil-

laries, and veins, but no waste-pipe. They are therefore called ductless glands. [5] There is nothing new made in the blood as it passes through them, hence they are not for secretion.

[6] One of these puzzling little chambers, called the thyroid gland, is located in the throat, a little above the breast-bone, and is fitted to the front of the trachea. It is divided into two little lobes, or rooms, each about two inches long, and half an inch wide. These rooms are divided many times by bands of fibre, so that they are filled with many small holes, a good deal like a sponge, and they are supplied with numerous blood-vessels. But what is all this for? This thyroid gland has been taken out of animals, and they have lived and apparently kept well. It is often diseased in human beings without causing any general disturbance. Expert chemists have analyzed the blood that passes through it, but can not find that it is in the least changed. We shall be obliged to say that we do not know of what use the thyroid gland is in our house. [7] The thymus gland is another ductless gland, which is not found in the House Beautiful after it has got its growth. [8] It is situated partly in the thorax and partly in the neck, and is made up of little masses of lobules fastened to a fibrous cord, and can be unravelled, as it were. In little babies it is quite large, and keeps on growing for the first two years of life: then it begins to wither, and finally disappears altogether. It would seem that it had something to do with growth, though we do not know what; but the little folks keep on growing, even if

we don't know, and none of us can tell when or how this strange little room disappears. The house does not change in its form, and we are unconscious that we have one room less.

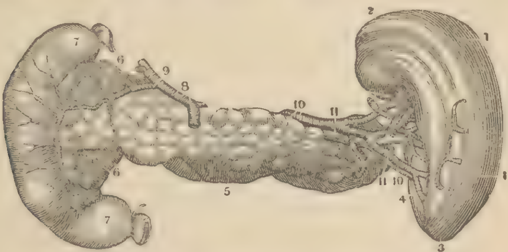
[9] There are some tiny little chapels at the base of the brain, called the pituitary body and the pineal gland, which are open to examination, but mysteriously closed so far as all knowledge of their use is concerned. [10] Who will ever find out and tell us about them? Perhaps some of you young folks. Who can tell? You have such quick, bright eyes, and are learning from us such wonderful things; and some day you will study for yourselves, and in turn become our teachers. But we are not yet through with the mysterious chambers. [11] There are two more, termed the supra-renal capsules, that are located near what we call the small of the back, but which physiologists speak of as the lumbar region. These capsules are attached to a couple of other rooms, called the kidneys. They are in shape like a flat triangle, about an inch and a half long. They are proportionately larger in children than in grown people. They are also without ducts. Their walls are made of cells inclosed in tubes, packed closely together. The interior is filled up with bands and holes, quite like a sponge, and they have many blood-vessels.

A great doctor, named Addison, thought he had discovered what these supra-renal capsules were for. He noticed that in a certain disease the skin became of a peculiar brown, and he found that in most of these cases the capsules were disorganized, or in a

dying condition; [12] and he concluded that they had something to do with the formation of pigment or coloring matter; for you know that dyestuffs are made in our house to color the hair and the skin, giving to some the hair and complexion of the blonde, to others that of the brunette. But after all investigation, and many experiments on animals, we are told that diseases of the supra-renal capsules do not always cause a bronzed skin, and people sometimes have that peculiar color when the capsules are healthy. They also tell us that the capsules are not necessary to life, that they can be removed without serious injury, and there they leave us, still asking, "What are they for?"

[15] But now we come to the last and largest of these mysterious chambers. It is a ductless gland; it is located on the left side, above the hip, and is called the spleen. [16] In a grown person it is about five inches long and four broad, and weighs but little more than six ounces. On the inside it, like the other mysterious rooms, is full of holes like a sponge. If a spleen is cut in two, on the surface of the pieces thus laid open to view there can be seen, with the naked eye, little round or oval white spots which have a big name, the *malpighian corpuscles*. They are little cells which grow on the branches of the splenic artery, like nuts on the branches of a leafless tree, and they are filled with capillaries. This makes a very pretty picture when we look at it through the microscope, these little clusters of cells on the arteries, but we do not know what they are for. [17] This whole spleen is a

conundrum which no physiologist has yet been able to guess. They have noticed that while the little people in the dining-room are very busy eating, the blood-vessels of the spleen become fuller of blood, and they have guessed it was a sort of reservoir for blood, or *diverticulum*, they called it; a place to which blood might be diverted or turned, if there was danger of too much going to the intestines. They have also noticed that the blood coming from the spleen



PANCREAS, SPLEEN, AND DUODENUM.

1. The spleen. 2. Its diaphragmatic extremity. 3. Its inferior portion. 4. The fissure for its vessels. 5. The pancreas. 6. Its head, or the lesser pancreas. 7. Duodenum. 8. Coronary arteries of the stomach. 9. The hepatic artery. 10. The splenic artery. 11. The splenic vein.

has a larger proportion of white corpuscles than elsewhere; and they have guessed that it was a place where white corpuscles were made. [18] Then, too, they have noticed that in the blood coming from the spleen there were fewer red corpuscles, and they have guessed that it was a place where red corpuscles were destroyed; but these are only guesses. No one says positively, "I know just what is done in that mysterious chamber." The ancients fancied that it had something to do with the temper, and when a person

was ill-humored they called it being splenetic, or full of spleen. Even people at the present day say, if they dislike a thing very much, that they "spleen against it," showing that the ancient idea has fixed itself in the language. Those ancients had some very queer ideas, and in many respects we are much wiser than they; but in regard to the spleen modern physiologists seem to know little more than the ancients.

13 They all feel sure, however, that it has something to do with moderating the appetite, a sort of regulator, as it were; for they find that dogs, when the spleen is removed, are voraciously hungry, and eat things they would not otherwise touch; but they act just the same way after other organs are removed, so that proves nothing. The spleen can be removed without destroying life, and one eminent physiologist says that is really all we know definitely about it.

Do you suppose these tantalizing rooms are merely little closets, put in to fill up niches and corners that would otherwise be empty, and that they serve no real purpose in the household economy? I don't think so, for the Great Architect never makes anything without a purpose, although we are not always wise enough to discover what that purpose is. At one time our whole house was as much of a mystery as these few chambers now are. Through many centuries men have been studying, and little by little they have learned what we have told you about the engine, the laundry, and the other wonderful apartments, and wise men are still studying, and some day in the future some one will explain to us all that now remains

a mystery. Physiologists are stimulated to study by the very fact of mystery. You remember that Bluebeard gave Fatima a key and told her not to open a certain room, and that made her desire very much to see what that room contained; and when she opened it, she found it full of the dead bodies of former wives who had been killed for yielding to their curiosity. But not thus will be rewarded the man or woman (and I wish it might be a woman) who shall unfold the secrets of our mysterious chambers. The name of that discoverer will be rendered immortal. The rooms are not locked; walk in and examine for yourself. Somewhere there is a key to the mystery, a clue to the unfolding of the secret, a hidden spring which, once touched, will reveal some wondrous transformation to our gaze.

CHAPTER XVI.

THE TELEGRAPH.

YOU are probably aware that the greatest telegraph system in the world is that of the Western Union Telegraph Company, the secretary of which has, at my request, kindly given me some valuable information regarding it. There are about fifteen hundred telegraph wires which enter their fine twelve-story building on Broadway, New York. There are two hundred and eighty thousand cells employed, in all their various offices, to generate electricity and keep up a current over nearly half a million miles of wire, over which pass forty million messages in a year. These figures are overwhelming, and you are doubtful about my finding anything to equal that in our little House Beautiful. Do not lose courage, young friends, but let us with a strong faith in our great Master-builder begin the study of our great telegraph system.

[1] Our great central office is located in the observatory, and is called the [2] *encephalon*, or, as we know it better, the brain. Here there are more than nine hundred millions of cells always busy making our electricity, which we call [3] nervous fluid, and sending it off over myriads [4] of little white threads which are our wires, and which are known as nerves. [5] Twelve pairs of these nerve-cables start out from the brain or

central office. As I told you, the great central office of the Union Telegraph Company is in New York; but in Philadelphia, Boston, Chicago, and all large cities, there are great offices scarcely less in importance, and from these, wires go to smaller way offices in all parts of the country. So in our house we have a series of branch offices. [7] They are located in the spinal column, from which [8] thirty-one pairs of nerve-cables are sent off.


THE NERVOUS SYSTEM.

You remember [9] how the backbone is made up of twenty-six bones placed one upon the other, each with a hole through it, thus making a [10] long tube, and it is in this tube that the spinal cord is placed. [11] It is made of the same material as the brain, that is, of gray cells and white connecting matter.

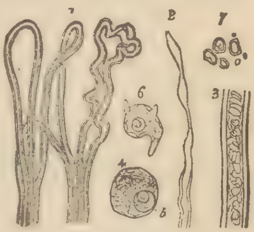
We should not be far out of the way to say that there are more nerve-cells located in various parts of the body outside of the brain, than are found in the

brain, so that we may reasonably calculate that we have, in each House Beautiful, two billions of cells which are generating nerve fluid, while the telegraph company has but two hundred and eighty thousand for all their offices, great and small.

[12] In the brain the gray cells are on the outside, but [13] in the spinal cord they are collected on the interior [14] and surrounded by the white matter. It is this [15] white fibrous material which forms the connecting wires or nerves, [16] and they issue from the brain and cord in [17] fine, white threads, and are distributed to every part of the body. [18] In certain places there are little bunches of nerve-cells and white matter. Each of these is called a *ganglion*—plural *ganglia*—and [19] each may be considered as a little battery. They are all very closely connected with the grand central office in the head by the nerve-fibres, and all together, [20] that is, the brain and its twelve pairs of nerve-cables, and the cord and its thirty-one pairs of nerve-cables, are called the cerebro-spinal nervous system.

Telegraph wires are insulated, that is, [21] kept from touching each other, sometimes by putting them up on poles at a distance apart, sometimes by wrapping each wire in a coating of lead and then forming them into bundles wrapped in another sheath, and the whole is called a cable. The nerves which pass from the brain and spinal cord might properly be called nerve-cables, for they are made up of bundles of fibres and each fibre is a nerve. When laid together in a bundle they are wrapped in a sheath called [22] the *neurilemma*, and the whole is also called a nerve, and

sometimes it becomes rather confusing, for we are not sure whether a single nerve is meant or a bundle. So we will use the term nerve-cable when we mean a bundle of nerves.



MINUTE NERVOUS STRUCTURE.

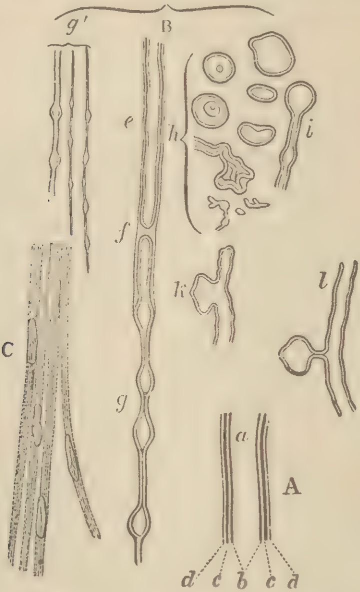
The microscopic elements of the nervous structure. 1. Mode of termination of white nerve-fibres in loops; three of these loops are simple, the fourth is convoluted. The latter is found in situations where a high degree of sensation exists. 2. A white nerve-fibre from the brain, showing the varicose or knotty appearance produced by traction or pressure. 3. A white nerve-fibre enlarged to show its structure, a tubular envelope and a contained substance—neurilemma and neurine. 4. A nerve-cell, showing its composition of a granular-looking capsule and granule contents. 5. Its nucleus, containing a nucleolus. 6. A nerve-cell, from which several processes are given off; it contains also a nucleated nucleus. 7. Nerve-granules.

[23] Each nerve is a minute tube, or tubule, filled with transparent material, which makes it look like a glass tube filled with a clear fluid. This material is called the [24] axis cylinder, and [25] through it nerve force is communicated.

Each fibre goes along by itself from its starting-point to near its termination, when it divides and subdivides and ends in [26] one of five ways: either in a fine network, or in little bunches or bulbs like the root of a lily; or in free ends; or in expansions called end-plates.

Sometimes nerve-cables get very sociable, [27] and interchange fibres as they go along, but each fibre still retains its own individuality. It merely leaves the neurilemma of its own cable and enters the neurilemma of another cable. This gives them a wider connection. It is like getting married, which, you

are aware, increases the number of our relations, and gives us a wider connection and more extended sym-

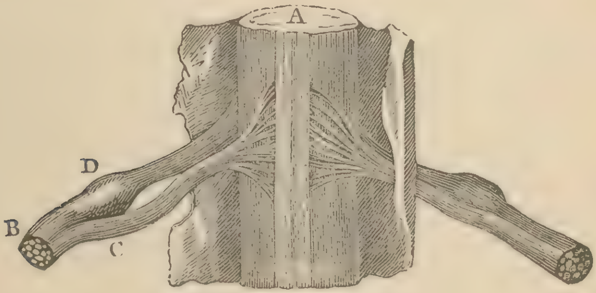


TUBULAR FIBRE OR SPINAL NERVE.

a. Axis cylinder. *b.* Inner border of white substance. *c*, *c.* Outer border of white substance. *d*, *d.* Tubular membrane. B. Tubular fibres; *e*, in a natural state showing the parts as in A. *f.* The white substance and axis cylinder interrupted by pressure, while the tubular membrane remains. *g.* The same with varicosities. *h.* Various appearances of the white substance and axis cylinder forced out of the tubular membrane by pressure. *i.* Broken end of tubular fibre, with the white substance closed over it. K. Lateral bulging of white substance and axis cylinder, from pressure. *l.* The same, more complete. *g'.* Varicose fibres of various sizes, from the cerebellum. C. Gelatinous fibres from the solar plexus, treated with acetic acid, to exhibit their cell nuclei. B and C are magnified 320 diameters.

pathies. So a nerve-cable will send off fibres at different points to join other cables, and in like manner

it will receive fibres from other cables. [28] But although fibres are thus sent from home, as it were, and become members of other cables, they never, at any point, lose their identity; they are one fibre from the beginning to the end, although through them, many cables may become connected. This explains why, when we are hurt, we may feel it in more than one place. It becomes a sort of family injury, you see, which affects all the members of the family. Some



Nerves from the Spinal Cord.
C. Anterior root. D. Posterior root.

one hurts Sarah's boy, and all of Sarah's family and relatives are indignant on account of it.

[29] Nerve fibres are of two kinds, those which convey sensations, as the sense of touch, [30] or the feeling of pain; and those which convey such [31] impressions as will produce motion. [32] They never interchange works. A nerve of sensation never conveys a command to produce a motion, and a nerve of motion never carries a sensation, or the notice of a sensation.

A nerve-cable may be made up of both nerves of motion and nerves of sensation; [33] but although they lie side by side they do not communicate to each other what they are doing, or what messages they are leaving along the line. [34] They always go to headquarters for information. Of the nerve-cables which pass out from the spinal cord, those [35] passing out from the front of it are made up of nerves of motion, while those from the back part of the cord are nerves [36] of sensation. In thinking this over you may have some trouble in remembering whether the nerves of motion, or those of sensation, come from the front or anterior part of the cord, and this may help you to remember it. When we make motions we like to see what we are doing; so we will remember that the motor nerves pass out from the front of the cord. We can feel without seeing, and that will help us to remember that the sensory nerves pass out from the back or posterior part of the cord.

By this wonderful Telegraph every part of our House Beautiful is connected with the central office in the observatory or head. The commands for any great changes in the movements of our feet, or legs, or hands, or arms, go from this central office.

Do some of you open your eyes at this, and say that you never before knew that you had within you a more wonderful telegraph system than any which man has devised? But you have it; and what is even more wonderful, you go along through life without thinking about it, or even without knowing it, and send and receive dispatches without making a mistake

CHAPTER XVII.

A WONDERFUL PHONOGRAPH.

DID you ever see a phonograph? It is a wonderful little invention. [1] A sheet of tinfoil is wrapped around a cylinder which is made to revolve. This cylinder is enclosed in a box, and the waves of air, produced by the human voice, directed through an opening in this box, cause a metal point to vibrate, and trace a waving line upon the tinfoil. If the tracer be returned to the point of starting, and the cylinder made again to revolve, the tracer will follow the track it first made, and you will hear repeated the song you sang, or the words you spoke, no matter how long since they were sung or spoken. You may think that I will have to try very hard to find anything like that in the beautiful house which we call our body. [2] It will not be just like it, to be sure, but it will be very much more wonderful. It is something which repeats, not what we have told it, [3] but that which the Great Architect has written indelibly upon it. We found the system of nerves which start from the brain and spinal cord, and which we call the cerebro-spinal system, to be of great interest. We saw that they formed a system of communication from the brain to all parts of the body and that the brain, and the bunches of nerve-cells

called *ganglia*, were the centres which governed and directed the sending and receiving of messages. We will now study a system of nerves which do not receive their orders from those general offices, the brain and cord, but find their orders written in their very substance.

[4] This is the sympathetic nervous system, and was so called because it was supposed to bind together all the various parts of the body into a whole, each part sympathizing with every other.

The sensory nerves of the cerebro-spinal system start out from the back part of [5] the spinal cord, and on these nerves we find little bunches of nerve-cells which we have already learned to call *ganglia*. [6] These *ganglia* are the beginning of one division of the sympathetic nervous system which we have likened to a phonograph.

[7] The other division of this system begins in the head, also in *ganglia* which are lodged on branches of the cerebro-spinal system. [8] There are twenty-eight or thirty of these ganglia, and they [9] pass in a double row down in front of the spine to its lower end. [10] You see that the two nervous systems are thus very closely connected in the beginning, and they are still more intimately united by threads, or fibres which pass back and forth between them.

[11] In every part of the body we find the ganglia of the sympathetic system, and [12] its fibres make a sort of interlacing network through every internal organ. They are in the [13] mucous membrane, the coats of the blood-vessels, in all involuntary muscles such as

the stomach, intestines, and heart, and even in the skin.

[14] In some places a great many fibres from different ganglia mingle together, forming a fine close network which is called a *plexus*. You will see that this makes a very close connection between the nerves, from which all these different fibres come, and enables us to understand how trouble in one part of the body may make pain in a part quite distant.

We have now learned the anatomy of these nerves. That is, we have learned their construction. We will next learn their physiology, that is, their working. The cerebro-spinal system receives messages from, and carries messages to [15] the brain; as in a telegraph system, messages are received at the general office. [16] But this sympathetic system, although conveying orders, does not receive them from the brain, but from the Great Architect himself.

In other words, the orders which it carries do not come from the brain, and are not under the control of the will. There are many things [17] going on all the time in the body which are not under our control, and all of these are governed by the sympathetic nervous system. [18] We breathe night and day, whether we think of it or not. This action of the lungs, taking in the air, and sending it out again, is according to the law which is written on the substance of each little ganglion of the sympathetic nervous system, just as the tracings are made on the tinfoil of the phonograph.

[19] We can indeed govern to a certain extent the action of the lungs. We can make ourselves breathe

fast or slow, while we are thinking about it; we can even refuse to breathe at all for a time. This we do through those fibres which pass from the brain and cord to the ganglia of the sympathetic. But we have only a very limited control of our breathing. As soon as we think of something else our lungs pass wholly under the control of the sympathetic system, and we breathe without thinking that we are breathing. And what a wise arrangement it is. For if we had to think of it all the time we should not be able to do anything else, not even to eat, or talk, or play. Up to [20] a certain point, swallowing is under the control of the brain, but after the food has entered the *œsophagus* it is then no longer subject [21] to the commands of the brain, but to the sympathetic nerves, and does itself, or, as we say, becomes involuntary.

It is well to remember this fact, and to put nothing into the mouth which it would be dangerous or hurtful to swallow.

[22] Digestion is a process that is wholly involuntary. As soon as food enters the stomach, the nerves of the [23] sympathetic system begin to trace the orders that have been divinely impressed upon them, and command the secretion of gastric juice, and the churning of the food by the stomach. When it is digested, they feel the impression that it must be passed along into the duodenum; [24] and here the order is given that pancreatic juice must be furnished; that bile must be squeezed out of the gall-bladder into the gall-duct, and sent where it is needed. [25] In this way the food is passed along into the small intestines, taken up by the *villi*, [26] transferred through mesenteric

glands to [27] the thoracic duct, and then emptied into [28] the jugular vein at the [29] left side of the neck. This routine is repeated every day; and every time food is taken into the stomach the tracer is moved back to the starting-point and repeats the divine orders. In this process of digestion all of the contents of the intestines are not absorbed. [30] Some of them are not nourishing, and are passed down into the scavenger-box, which is the large intestine or colon. Through this same system an order is sent to a couple of strainers called [31] the kidneys, which are located in front of the small of the back, and in obedience to this order they separate from the blood [32] the watery portion, which has become waste matter, and send it out into a store-room called the bladder, where it stays until a command comes from the brain for its removal. The more solid contents of the colon, which are to be cast out as waste, pass down into a portion of the bowel called the rectum, and are expelled from the body. You may well imagine that this casting out of waste material is an important part of physical housekeeping. No good housewife allows waste to accumulate about the house. In the emptying the waste pipes of our bodily dwelling, we find the closest connection between the two nervous systems. Until the moment that this material is ready to be thrown out of the body, the sympathetic system has worked without consulting the brain. But now word is sent from that general office that the doors shall be opened and the waste expelled. This order is a very important one, and should at once be heeded, if we wish to preserve a clean, healthful dwelling.

CHAPTER XVIII.

THE BURGLAR ALARM.

MAN'S inventive genius has devised a delicate electrical instrument, which he, no doubt, has believed to be something entirely new. It is called a Burglar Alarm. It consists of an electrical battery connected by wires to every door and window of a dwelling. As soon as the last door is closed the current of electricity is established, and everything is supposed to be safe. If a door or window is opened the current is broken and a bell sounds the alarm, telling in what part of the house an entrance is being attempted. Of course the man who lives in the house lies awake to see if his alarm works right, for he would not want to spend so much money and then have a failure.

If he hears the alarm he is at once greatly frightened, for, as this machine is a Burglar Alarm, the ringing of the bell implies that a burglar is at hand, and at once the man jumps out of bed and into a few of his garments, and then into a closet and shuts the door. He knows that burglars always want the most valuable thing in the house, and, without doubt, that is himself. His timid little wife, who knows that she is of no account, and therefore in no danger from burglars, goes down-stairs to see what is the matter, and finds that the burglar is Bridget, who had the

toothache, and was going to the kitchen for her drops. When, a few nights after, the real burglar does come, he opens neither window nor door, but cuts out a large pane of glass and thus effects an entrance, and neither the alarm nor its owner know anything of his presence.

No such good-for-nothing [1] Burglar Alarm has been put into our House Beautiful, but one so perfect in the certainty of its workings was put into the first house, that the same kind has been put into each succeeding one. [2] You have already learned that batteries are placed in the Observatory, [3] and in the Telegraph you studied the general construction and distribution of wires. [4] Some of these same batteries and wires are used in the Burglar Alarm, [5] and the connection with every part of the house is so minute, that you can not put the point of the smallest needle upon the skin, without the owner's being aware of it and warning you to stop. [6] The nerves, which act as the wires, start out from the posterior part of the spinal cord, and are known as nerves of sensation, and when they are irritated, or injured, we feel pain, and this is the alarm.

[7] Pain is our very good guardian and friend, who is ever on the alert to warn us when danger threatens our house. [8] We do not like his warnings, but, nevertheless, we should always heed them, for he never speaks without a good reason.

[9] The nerves of sensation end in the skin in tiny bulbs called tactile corpuscles. [10] These are found in greatest numbers in the palms of the hands, on the

palmar surface of the fingers, and on the soles of the feet. [11] If we look at the ends of our fingers we can see little rows, or lines, which are the papillæ of the skin, and it is in these papillæ that the nerves of sensation end. [12] The tactile corpuscles do not exist in all of the papillæ, and they are in greater proportion in some parts than in others. [13] On the ends of the fingers there are about four hundred papillæ and one hundred tactile corpuscles, [14] while on the second joint of the finger there are only forty corpuscles, to the square inch. In the skin of the forearm—[15] that is, the arm between the wrist and elbow—[16] these corpuscles are rare. This shows why some parts of the body are more sensitive than others. Pain is not the only sensation we have. [18] We can tell whether things are warm or cool as well as whether they burn or freeze. We can judge of the shape of things, and of their surface, whether they are rough or smooth. We can feel pleasure in the touch of velvet, as well as pain from the touch of a very rough surface.

[19] The sense of touch has been so highly cultivated in deaf people, that they experience pleasure from the music at a concert by placing their finger-tips upon the backs of the benches.

Thus our Burglar Alarm, like other senses, at one time gives us protection, and at another gives us pleasure.

CHAPTER XIX.

THE SIXTH SPECIAL SENSE.

[1] YOU have doubtless been told that you have five senses, and perhaps you will be surprised when I tell you that you have a sixth sense. [3] You can tell me—even if your eyes are shut—whether you are sitting or standing; whether your feet are crossed or not; whether the palms of your hands are turned toward the earth or sky.

How was the knowledge of the position of the muscles communicated to the brain?

[4] When you are told to bring in a pail of water, you do not stop to think how much effort you must put forth, to lift it. You really take no thought, but you take hold of the pail. [5] You do not have to try twice before you succeed in lifting it, nor does it fly into the air because you applied too much force; but you put forth just the right amount of strength to lift it easily.

[6] It is this sixth sense which knows for you how much force to use; whether an object is fixed, or movable, and also the position of your muscles. [7] This we call Muscular Sense. [8] By Muscular Sense you learn the weight of different substances. [9] So acute does this sense become by cultivation, that a differ

ence of one-sixteenth in the weight of two articles — as two pieces of coin—can be detected.

Step into a bank some day and watch the teller counting gold pieces. See how rapidly he counts, and yet the instant he touches a coin that lacks the required weight, his muscular sense detects it, and it is thrown out with unerring certainty.

[10] Through muscular sense we have a knowledge of what we are walking upon—whether the grass, the stone pavement, a board walk, or an ash-heap.

Sometimes we appreciate our powers better after we have lost them. [11] It may seem strange, but it is true, that if a person has lost this muscular sense, in his back and legs, he can not walk across a room with his eyes shut, without staggering like a drunken man. [12] If, with his eyes closed, he attempts to stand erect, he will fall over. This shows you how one sense assists another. [13] The eyes, in a measure, take the place of this lost sense.

[14] A person who has lost Muscular Sense needs to pay very close attention to everything which he undertakes to do. [15] A mother thus affected could hold her child in her arms so long as she thought of holding it; but as soon as any one began talking to her, and directed her thoughts away from the baby, her arms relaxed and the child began to fall. You can see that muscular sense is very important, if without it you can not hold a child safely in your arms, or walk steadily across the floor. [16] My neighbor, who has been blind some eighteen years, is, with his two brothers, a dealer in live stock, sheep, horses, and

cattle. He feels of the sheep, and judges of the quality of the wool; he lifts them, and judges of their weight, and decides on their value. He feels the horses all over, judges of their size, form, condition, and speed, and describes them better than his partners who have eyes, seldom making a mistake even in the color of the animal. His is the best judgment of the three, and his brothers always acquiesce in his decisions.

17 Muscular sense is always well developed in those persons who perform feats of physical strength. Recently in one of the great fires in New York city, near the post-office, a young woman was seen to come to one of the front windows in the third story. She stepped into the window and stood erect upon the sill. In a few moments the smoke came pouring out of the same window, and flames were surrounding her. She must move. She could not retreat. She saw that the next window was not on fire, and if she could reach it, she had one more chance of rescue. She spread out her arms upon the perpendicular wall, passed along a projection not three inches wide and reached the window. No human being could have done this without so great an emergency, to stimulate muscular sense to its utmost capacity.

The crowd below gazed in amazement. Here again she stood upright upon the window-sill, from which she would have fallen in a moment under any other circumstances. The firemen tried to make her understand that they would take her down with a

ladder, if she had courage. She nodded that she understood, although their voices could not be heard. While they were bringing the ladders, another young girl jumped from another window, with the expectation of alighting upon a canvas held by a number of men below. In her descent she struck a telegraph wire, which turned her over and over, and she was killed in the fall. The girl stood in the window unmoved. The fire now appeared behind her. The ladders came, but were too short. A fireman ran to the top of the ladder, and, standing upon the topmost round, could only reach high enough to take her by the ankles. "Can you be perfectly cool?" he cried to her, "and make yourself as stiff as a piece of iron?" "Yes," she said. "Then I will lift you down," he replied. He took her two ankles in his two hands, and lifted her up, she being perfectly erect, and stepped down from one round to another, until he placed her feet upon the ladder; and then taking her in his arms brought her safely to the ground amid the tears and embraces and shouts of the assembled multitude. Neither of these two ever before knew how great were the powers of their Muscular Sense.

CHAPTER XX.

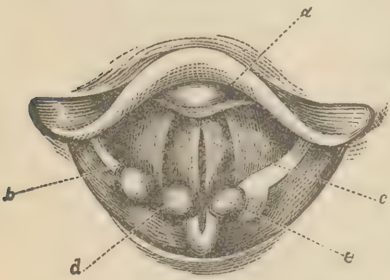
THE ORGAN.

If you were asked to name the [1] finest musical instrument you have ever heard, what would it be? Some of you would think of the violin, some of the flute, and others of the piano. But what if you should be called upon to tell why it was the finest instrument, and to describe how it is made, what then? You might not be able to describe it, and probably you would only be able to say that it is best, because you like it best. I can tell you of an instrument, which I think the finest of all instruments, and I will try to describe it to you, and tell you why it is the most wonderful of all instruments.

[2] Please put your finger on your throat, and you will feel a little protuberance called Adam's apple. I guess when Adam was called upon to tell why he ate the apple, he was in such a hurry to say that Eve was to blame, that he attempted to swallow a quarter of the apple whole, and it stuck in his throat. At any rate, there it is in the throats of all of Adam's sons and daughters. It is larger in the throats of men than of women. It is called the larynx. [3] It is a firm sort of a box, situated just at the top of the trachea or windpipe; it is a box with sides, but without a top or a bottom. [4] It has a lid which can close it at the

top, but it usually stands open. This lid is called the *epi-glottis.* It is [5] open to admit air, which must pass through the larynx and trachea into the lungs, [6] and it closes when food passes across the top of the larynx, on its way to the œsophagus and to the stomach.

[7] Near the top of the larynx two bands or chords of fibrous tissue stretch across it from front to back. [8] They lie parallel with each other, leaving a little crack between them. There would be a space between them and the walls of the larynx, but it is closed by a membrane and by muscles.



THE ORGAN.

[9] If you will put the tips of your thumb and forefinger together in each hand, and then put your hands side by side so that the thumbs lie parallel, but not quite touching, you will have a very good representation of the larynx, [10] your thumbs being the vocal chords; only you want to fill up the spaces between your thumbs and your fingers, so that the air can only come between your thumbs. [11] This opening is called the opening of the glottis, and the space below is the glottis. [12] When we breathe, the glottis gets larger as the air comes in, and smaller as it goes out.

How is this done? At the back of the larynx the chords are attached to two small pieces of cartilage

shaped like a triangle, the bases of which are fast to the larynx and can be rotated, so that their opposite angles can be more widely separated from each other and thus the chords are drawn apart.

Now, if your thumbs were thin, delicate ribbons—remembering always that the space between thumb and finger is filled in with muscle—as the air passed through between these they would be moved back and forth. [13] That is called vibrating, and this vibrating, [14] if sufficiently rapid, would make a sound which we call a tone.

You have often stretched a string across a window, and listened to the music which the wind made by blowing over it and vibrating it. You found that the tone varied with the length of string, [15] a short string making a high tone, a long string a low tone. The tone also varies with the tension and size of the string. In the piano, strings of different sizes and lengths are used to make the different tones. [16] If our larynx is to be a musical instrument, it must be able to make tones of different pitch, or it will be of little account. But we have only two strings to use; how can we vary them in length and size?

[17] There are nine little muscles, so arranged that they can draw the chords nearer together or farther apart, and at the same time tighten or loosen them; the tighter they are drawn, the higher the tone, as you found in your Æolian harp.

[18] In sounding a low tone the glottis is left quite open, and the vocal chords are loose. The nearer the chords are brought together, the narrower the glottis;

and the tighter the chords, the higher will be the tone.

[19] In a flute a column of air is made to vibrate, [20] and the pitch of the note varies with the size of the opening, and with the length of the vibrating column of air, within the flute.

[21] The human voice is made by forcing air through the opening between the chords.

[22] We find that in low sounds the column of air is shortened by the lowering of the larynx, and in high sounds it is lengthened by the raising of the larynx.

[23] If you could draw out one of the reeds of your melodeon, or parlor organ, you would find it to be a piece of brass, with a brass tongue which vibrates with the movement of the air. The smaller the tongue, the more rapid the vibrations and the higher the tone. So with the [24] vocal chords, the shorter and thinner they are, the higher the pitch; the muscles draw them together and stretch them tightly, and the [25] air, coming from the lungs and passing through the glottis, makes them vibrate, and they, in turn, cause the column of air in the trachea to vibrate.

The piano and violin have each a [26] sounding-board, which helps to develop the volume, and the quality of tone.

There is in the frontal bone, above the eyes, a cavity filled with air, that communicates with the nasal passages, and which, together with the throat and mouth, forms a sounding-board and gives resonance to the voice.

In a church organ we have a boy to blow the bel-

lows and pump in the air. [27] The bellows of the voice are the lungs, and the boy who pumps, is a [28] combination of muscles, located, not only around the lungs, but also in the abdomen. Many people never learn to use the abdominal muscles in breathing, and therefore they never have the most complete control of their vocal organ.

We all know that there is a difference in the [29] quality and pitch of different voices. [30] Sometimes the trachea is short and wide, and then the vocal chords will be long, and their vibrations will be slow, and that will produce the low tones of a bass voice.

If the trachea is longer and narrower, the chords will be shorter, and will [31] vibrate more rapidly, and this will give the quality and compass of a baritone, or tenor voice. [32] If now the chords are smaller in size we will have a contralto voice, and if still smaller, a soprano voice. [33] Thus you see that our very simple instrument of two strings has developed wonderful capabilities in the production of a great variety of sounds. [34] The range of the human voice is about four octaves, that is, from the lowest bass tone to the highest soprano tone. [35] The average range of a single voice is about two and a half octaves. Madame Parepa Rosa, as well as Patti, had a compass of three octaves. The ability to sing high or low is not the only difference in voices, [36] for even in making tones at the same pitch, there is often a marked difference in quality. This is called the *timbre* of the voice. [37] It depends upon the formation of the chords and the larynx, and not less upon the knowledge of how

to use the abdominal muscles, and how to place the chords in order to make the required tone. One may have a very good organ and not know how to use it, or else use it in a wrong way and so not develop it to the best advantage. [38] A good teacher can change the *timbre* of a voice, by teaching the owner how to use the muscles by which it should be worked. [39] The strength of the voice depends partly upon the degree of vibration of the chords, and partly upon the resounding qualities of those parts which act as a sounding-board.

Are you able to see why this organ is the most wonderful of all musical instruments? [40] It is like a violin, because it has strings which are made to vibrate, sometimes producing a higher or lower note, and in both voice and violin the long string makes the low tone, and the same string tightened a higher tone.

[41] It is like a piano, because it has strings vibrating in connection with a sounding-board.

[42] It is like the flute, because it has a column of air in a tube, which, put into vibration, causes a tone. [43] It is even more like an organ, for there we have a column of air put into motion by a vibrating body. In the church organ each tone is produced in a different pipe, each pipe producing but a single tone. But the pipe in our organ—the trachea—can be made longer or shorter, or larger or smaller, as is needed. It is really wonderful how many different tones can be produced by this simple little instrument. The manner of producing the tones is not more wonderful than is the beauty of the tones produced. Neither

flute, violin, or organ can make such fascinating sounds as the perfectly attuned and properly educated human voice.

The most perfect human voice can be heard distinctly above thousands of other voices singing at the same time, because the multitude of voices will not be so perfectly accurate. This was demonstrated by Mme. Parepa Rosa at the Boston Jubilee, where the precision and mathematical accuracy of her tones, enabled them to be heard in the midst of more than a thousand singers, and nearly as many instruments.

It must have been after attending such a glorious and almost divinely inspiring *Symposium*, that Raphael conceived and painted that masterpiece of art, where St. Cecilia is represented as singing, with her beautiful face turned heavenward, while kneeling men and hushed angelic choirs, forget the loveliness of her face, in listening to the ravishing tones of her human voice.

CHAPTER XXI.

THE AUDITORIUM.

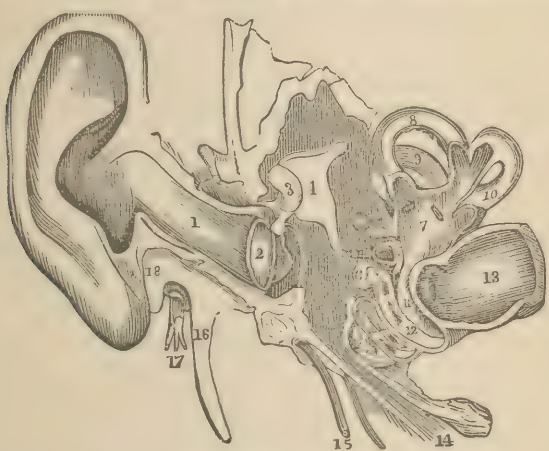
THE visitor, in entering one of our finest houses, passes through a porch, or vestibule, into a hall, and is then shown into a reception-room, where he waits until his name is taken to the gentleman of the house. This room might properly be called the auditorium, because in this room are heard all desires and requests. As a rule, such rooms are furnished with a few easy-chairs, a lounge, a magazine, and a few papers with which to while away the time of waiting.

In this house, not made with hands, which we inhabit, we can find two rooms which correspond to this auditorium. They are so connected with each other, and that, too, without an opening between them, that whatever happens in the one is at once known in the other.

Looking upon the sides of the Observatory we can see the porches which protect the entrances to our double auditorium. They are very pretty little porticoes, of a peculiar semi-circular shape, a pearly pink in color, and are ornamented with carvings or mouldings, strange hollows, and ridges, which surround a deeper part, in the centre of which is the entrance.

[1] This portico is called the *pinna*, or external ear. This indicates that there is an internal ear. [2] The

pinna is attached to the observatory by ligaments, [3] and each has three servants, or muscles, but they do little work. One is called [4] "the servant who raises the ear"; another, "the servant who pulls the ear back"; but you can tell, by trying, that they are of [5] very little account in moving the ears in any direction. I have seen people who had these servants so



STRUCTURE OF THE EAR.

1. Auditory canal. 2. Drum of ear. 3. Hammer. 4. Anvil. 5. Stirrup. 6. Middle ear. 7. Vestibule. 14. Eustachian tube.

well trained, that they would move the ears as they were ordered.

In the centre of [6] the pinna is a round doorway, without a door to close it. There are, [7] however, some guards stationed there to keep out intruders. This [8] doorway leads into a hall, or passage, which is very much like a tunnel. It is a cylindrical channel lead-

ing into a bone, which is so extremely hard that it is called [9] the petrous, or rocky portion of the temporal bone.

[10] This bony canal is called the auditory canal, and is lined inside with membranes, like tapestry, so that we do not see the walls. It is not a straight canal, but [11] at first it goes up a little in order to get over a bony prominence; then it goes down a little, and all the time it is going a little forward. [12] It also gets somewhat smaller as we proceed.

We soon reach the inner end, for [13] it is only an inch and a quarter long, and here we [14] find our way stopped by a flesh-colored curtain. It is not such a *portière* as fashionable ladies have nowadays in their houses, that are hung on rods, with rings which slip easily, and let one pass; but it closes up the hall just like the bottom of a box. There is no way to get through it. [15] It will not move, and there is no opening in it. We are stopped here, and we have not reached the reception-room. But come with me, and I will show you how we can get around on the other side of that curtain. We will enter [16] the round doors under the portico of the nose, and go back into the pharynx, which is the upper and back part of the throat. If we then look up a little, and to one side, we will see a small round opening. This is the entrance to another passageway, leading to the auditorium or reception-room.

This [18] hall is about as long as the one leading from the pinna, and is [17] called the eustachian tube. Here we are then, behind the curtain, and [19] in the audito-

rium, or middle ear, which is an irregular cave hollowed out of the [20] same rocky bone. The usual visitors do not come in as we did. Whoever gets in here must pass directly through the substance of this curtain, [21] which is called the drum of the ear, because it is tightly stretched across a round opening. It is not stretched straight up and down, but [22] the top leans outward, so that the floor of the canal is longer than the ceiling.

The auditorium, where we now are, has its own peculiar furniture. There are no easy-chairs, or books, or pictures. [23] First there is the drum we have been talking about, but there is no use in having a drum if we have no drum-sticks. Well, a hammer will answer, will it not? And here we find a tiny one fastened, [25] along the length of its handle, to the drum-head, from the top to the centre. The head of the hammer is at the top, and so close that it can touch it, we find—can you guess?—an anvil. [24] So you see that the head of the hammer plays on the anvil, and the handle plays on the drum-head. Is it any wonder that boys and girls are so fond of noise when they have two reception-rooms apiece, each fitted up with drums, hammers, and anvils? You might as well give a baby a rolling-pin and looking-glass to play with, and expect nothing to be broken, as to furnish a child with two drums, two hammers, and two anvils, and expect no noise to be made. I have not yet told you of all the strange furniture that we find in the auditorium. [26] You know that a stirrup is a part of a saddle. One of the strangest places I ever knew of for

keeping a saddle is under the bed, and I think it is about as odd to keep a stirrup in a reception-room. One in each auditorium makes a pair, doesn't it? I wonder if that is why children are so fond of riding that they will even ride a broomstick, if they can have no other steed?

I sometimes have a good laugh when I think of all the odd things which I find to tell you about in this beautiful house of ours. Now you can not guess for what this stirrup is used. You have sometimes seen, no doubt, old coats or hats used to stuff in a window where part of the glass was broken out, but I am sure you never saw a stirrup used to close up the whole window in the place of glass. [27] That is how the stirrup in this auditorium is used. The base, or foot part of it, fits snugly into an [28] oval window called the *fenestra ovale.*

[29] The hammer, the anvil, and the stirrup are tiny bones which are so [30] arranged as to touch each other. It is necessary to keep the [31] drum of the ear in tune like a musical instrument, and this is done by [32] three servants or muscles. [33] Two of them are attached to the hammer, and one to the stirrup. [34] When they act, the centre of the drum-head is drawn in a little; the tiny bones are firmly pressed against each other, and the stirrup presses against the membrane in the oval window. By this action, the tension of the parts is such that a wave of air, [35] striking the drum-head, communicates its force to the hammer, and through the hammer to the anvil, and through this to the stirrup, and through the pressure of the stirrup

against the membrane in the oval window to the fluid which is in the internal ear.

There is a difference in the position of the drum of the ear in different individuals, and it has been observed that those persons are best musicians, in whom it is more nearly vertical. When the ear is tuned to hear the highest notes, an octave or more above the ordinary range is distinctly recognized; while at the same time low tones, that before were heard, are now not audible.

[36] The auditorium, or middle ear, is filled with air of the same density as the outer air, and is [37] in com munication with it through the eustachian tube, by means of which we entered the auditorium. There are three servants who have charge of this tube.

Sometimes a sudden concussion, as by a blow or from jumping, causes partial deafness or pain in the ear. It is well to remember that [38] swallowing, or moving the jaws sideways a number of times, may relieve the difficulty, by restoring the equilibrium between the air in the middle ear and the external air.

The density or pressure of the outside air varies with every change in the weather, and if that in the auditorium was not of the same density, the drum could not vibrate so perfectly, and of course one could not hear as well. This equilibrium is kept perfect through the eustachian tube.

Is it not wonderful that our ears must be kept in tune like a musical instrument, and that this is accomplished by means of two membrane drums, in

connection with six little bones, in the form of two hammers, two anvils, and two stirrups?

It is almost beyond our comprehension how we can use this ingenious device of delicate parts so as to hear everything, as we do, without knowing how it is made, or how arranged, or how managed; for those who know nothing about it appear to hear quite as well as those who know the most about its construction. But the most wonderful fact is, that the Great Architect who gave it to us has made it so perfectly, that it keeps in order so many years.

> "Strange that a harp of ten thousand strings
> Should stay in tune so long!"

CHAPTER XXII.

THE WHISPERING GALLERY.

If you should ever visit the Capitol at Washington, you would observe that a portion of the building is round and raised above the roof. This is called the dome, but it might well be called an observatory, for from it you obtain a fine view of our magnificent public buildings, which are not surpassed by any in Europe. The space within the dome, from the floor to the top, is called the rotunda. A small gallery runs around the inside of this rotunda at a height of nearly two hundred feet above the floor, and it is in this gallery that we are called upon to listen to the echo of a whisper. If you stand at one point and whisper ever so softly, your friend, who is standing on the opposite side of the gallery, can hear the sound much more distinctly than you can; for the round walls reflect, or throw back the sound-waves, and concentrate them, at one point, where they become very loud and distinct.

There is a famous whispering gallery in St. Paul's Cathedral, in London, and there are others in other public buildings in Europe.

You will be surprised when I tell you that within our Observatory we have a whispering gallery. But

knowing, as you do, who the Great Architect is, you will not question my statement that it surpasses all whispering galleries made by man. It is, not only, more ingenious in its construction, but it is far more perfect in its workmanship and is eminently practical and useful.

In order to enter this Whispering Gallery, we will start from a [2] chamber in the Observatory among the brain cells, called the fourth ventricle. Here we find [3] two little white threads which form the clue to guide us. [4] They together form what is known as the soft portion of the seventh pair of nerves. This nerve winds affectionately around the mother of all nerves, [5] gently kisses its sister, the facial nerve, and then modestly covering itself in its sheath, hides itself in the [6] stony portion of the temporal bone. [7] There it divides, and a portion of it goes [8] to the vestibule.

In [9] studying the Auditorium, we found that the force of the sound-waves was [10] transmitted through the chain [11] of tiny bones until it reached the [12] stirrup which closed the oval window. If now we pass through this oval [13] window, we enter the vestibule, which is the first division of the [14] Whispering Gallery, or internal ear. [15] We have already reached the same place from the opposite direction, following the nerve as a guide. This [16] vestibule is the entrance to a strange series of winding galleries, known as the *labyrinth*, which means a place full of windings.

The first thing which attracts [18] our attention are two sacs, or bags, which fill nearly two-thirds of the vestibule. One of these is large and of an [19] oval

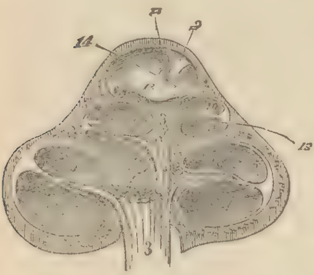
shape, and is called the *utricule*; the other, small and round, is [20] called the *sacule*. These bags contain little [21] six-sided bone stones, which have the name of [22] *otoliths* or *otoconia*. And what are they for? That is another riddle which our wise men have not guessed. We know that [23] they exist only in man in mammals, and in reptiles.

THE LABYRINTH.

The labyrinth of the left ear, laid open to exhibit its cavities and the membranous labyrinth. 1. Cavity of the vestibule. 2. Ampulla of the superior semi-circular canal. 4. The superior canal, with its contained membranous canal. 5. Ampulla of the inferior canal. 6. Termination of the membranous canal of the horizontal semi-circular canal in the sacculus communis. 7. Ampulla of the middle semi-circular canal. 8. The same canal with its membranous canal. 9. Common canal. 10. Membranous common canal. 11. Otoconite of the sacculus communis. 12. Sacculus proprius; its otoconite is seen through its membranous parieties. 13. First turn of the cochlea. 14. Extremity of the scala tympani, corresponding with the fenestra rotunda. 15. Lamina spiralis. 18. Half turn of the cochlea. 19. Lamina spiralis, terminating in its falciform extremity. The dark space included within the falciform curve of the extremity of the lamina spiralis is the helicotrema. 20. The infundibulum.

Opening out of the vestibule [21] are five small, round doors, and one large one. If we enter any one of these small doors, we find [25] ourselves in a cylindrical, membranous passage, which is surrounded by [26] a similar one of bone. [27] There are three of these passageways, and each [28] contains nothing but a little fluid, and some of these six-sided ear bones or otoliths. They [29] curve round much like the bow in the yoke of an ox, and following any of these windings,

we are brought again to [30] the vestibule from which we started. That portion of the nerve which comes to the vestibule is [31] distributed to little hair-like processes which are found among the otoliths. [32] These stones are found so near the nerves, that some think them to be at the ends of the nerves; but [33] since we have found out that we can hear without them, we are compelled to say that we do not know what the otoliths are for.



THE COCHLEA.

The cochlea divided parallel with its axis through the centre of the modiolus. 1. Modiolus. 2. The infundibulum. 3, 3. Cochlear nerve. 4, 4. The scala tympani of the first turn of the cochlea. 5, 5. Scala vestibuli of the first turn; the septum between 4 and 5 is the lamina spiralis. 8. Loops formed by filaments of the cochlear nerve on the lamina spiralis. 9, 9. Scala tympani of the second turn of the cochlea. 10, 10. Scala vestibuli of the second turn. 11. Half turn of the scala vestibuli; the dome over it is the cupola. 14. Helicotrema; a bristle is passed through it, in front of which is the hamulus.

On one side of the [34] vestibule begin two pairs of winding stairs, or rather inclined planes, divided by a wall. Ascending them, [35] winding around twice and a half, we find the same arrangement at [36] the top, as in a snail-shell; in fact, it is just like a snail-shell, and is called [37] the *cochlea*, or screw. Looking more closely, we discover that the [38] wall between these two inclined planes is hollow, and inside of it [39] is another little stairway. Mystery upon mystery! Let us investigate.

[40] This stairway is filled with a fluid, and extending

[41] all the way to the top are two rows of queer, tiny, club-shaped bodies, [42] standing with their big ends uppermost and leaning against each other. [43] Thus they form a covered way or arcade between them. [44] There are about nine thousand of these hair-like pillars, and [45] they are so short that it would take two hundred of the longest, or five hundred of the shortest, to make an inch in length. [46] A strange thing about it is, that the shortest ones are at the bottom, where there is

TWO PILLARS OF THE ORGAN OF CORTI.

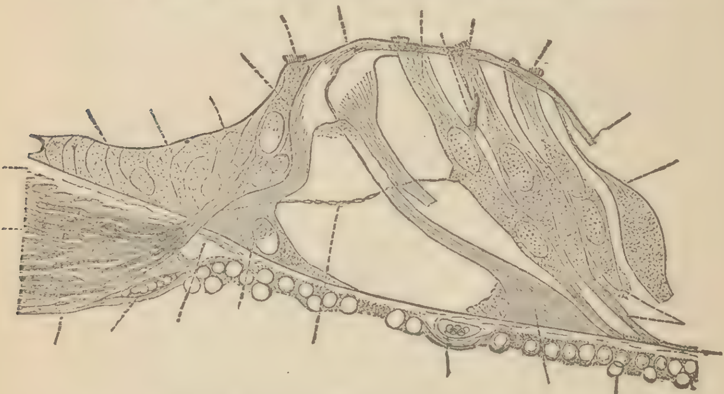
The one to the left is known as the external, the next one as the internal pillar of the Organ of Corti. They are separated so as to see their form, the upper and lower extremities. The little round spots at the base are cells. When united, **as seen at the right, the space between them is the arcade.**

the most room, [47] and the longest at the top, where the space is least. [48] They are called the pillars of Corti, because a man named Corti first described them. [49] All, together, they are known as the *Organ of Corti.*

[50] The second branch of the nerve goes to the cochlea; where, breaking up into innumerable branches, it winds up the spiral stairway, and spreads out between two thin, bony plates. Here these little threads pass through a knot of [51] nerve-cells called a *ganglion*, after which they become so minute that we

can not follow them; but [52] it is believed that they end in the organ of Corti, that wonderful instrument, that arrangement of rods like the strings of a miniature harp.

But how is it that we hear? If you throw a stone into a lake or pond, or even into a tub of water, you will see waves start from the point where the stone



SECTION OF THE ORGAN OF CORTI FROM A DOG.

At the left of the figure, on the lower border, enters the nerve, and a small nerve-fibre passes across the figure to a hair-cell, and, in so doing, passes over the arcade, above the centre of which can be seen the union of the two pillars of the Organ of Corti.

entered the water, and following each other from this point, they will form an ever widening circle. The same is [53] true of the air, except that we can not see the waves.

If you stand in the centre of a room and clap your hands, waves of air will be created which will radiate from that point in every direction. If you strike [54] the head of a drum, the sound waves will be larger

than if you strike a stone wall. That is because the head of the drum can vibrate more.

These sound waves [55] strike the drum of the ear and cause it to vibrate. [56] Irregular shocks communicated through the air produce what we call noise. [57] When the shocks are such that we can count them, we call them strokes. But if they are very rapid, as when made by the wings of a bee, [58] we have a hum or buzz produced or, possibly, a musical note. [59] The uniform vibrations of the strings of a piano, or violin, produce air-waves, which are conveyed to our internal ear, and which we recognize as musical tones.

Music is a secret which the trembling strings whisper to the air, and the air tells it again to this wonderful instrument which we find in the Whispering Gallery, this miniature harp with its thousands of strings, which in turn whispers it to our consciousness. "But how do the pillars of Corti reveal this secret borne on the air-wave?" "How can they whisper it again to the Lord of the mansion?"

If I take a tuning-fork which gives a note of the pitch which we designate as "A," and which we know has a given number of vibrations in a second, and fasten it upright on the table, and ten feet away from it fasten another of the same pitch in the same position, and then draw the bow of a violin across the first one, you will hear it sing. If now I put my hand upon it, and stop its vibrations, you will still hear the same tone, and will find that it comes from the other tuning-fork, which has not been touched by the bow. This proves that the second fork has heard what the

first was saying, and is repeating it to you. [60] These tones are called tones of influence. I will give you another illustration. Take a piece of hard wood, and place one end on the sounding-board of a piano, and passing the wood up into the third story, place upon the upper end a violin, and the music made upon the piano in the first story will be audibly repeated by the violin in the third story.

The little pillars of Corti, which stand bathed in a fluid, are so made that they [61] are acted upon by the tones of influence, just as the tuning-fork and violin were. And they are ever whispering to us the [62] tones carried to them, by the vibrations of the external air, through the auditory canal, and the mechanism of the middle ear, the drum, the hammer, the anvil, and the stirrup. As there are nearly nine thousand of these little whisperers they can repeat to us nearly every tone that can be made. They stand waving to and fro in the fluid which surrounds them, and it is believed that the stirrup pressing upon the membrane of the oval window, and thus upon the fluid in the labyrinth, conveys the impression made by the air in waves without, to these rods, the organ of Corti, in which the nerves end; and that they convey an impression to the brain, which we call the sensation of hearing.

It is wonderful how this organ of Corti repeats to us the most varied shading of tones. The same note may be produced upon the violin, the flute, the piano, the violoncello, and yet the whispers inform us correctly which is which. The number of instru-

ments may be greatly increased, but still the tones of influence whisper to us of every instrument, and every change that it makes. [63] It is possible for the human ear to recognize tones varying from forty vibrations in a second, to thirty-eight thousand per second.

[64] The best ear has a range of about eleven octaves. [65] Six or seven octaves is the usual limit. There are persons who are not able to hear anything beyond the middle "E" of the piano-forte.

Such an one [66] could not hear the chirp of the common sparrow, which is pitched fully two octaves above that note, much less could he hear the song of the cricket, or the squeak of the bat, which is still higher by another octave.

These highest tones must be produced by very little waves, so small, in fact, that we might think them of little importance, but we would be mistaken. When we stand upon the sea-shore and listen to the beating surf, we easily recognize the power and force of water. And we might imagine that there are no waves more destructive than those of water. But did you ever think how quiet and harmless is the vast ocean when left alone? [67] The waves of air are the disturbing element which produce the waves of water. It is not always the large waves that do the most harm. [68] It is the small wave that awakens envy, hatred, malice, and revenge. It is the small wave which speaks in slander that is more destructive than tempests. The tiny waves of a whisper may wound a heart or ruin a life.

But waves are a blessing, as well as a source of harm.

[69] The agitation of ocean tends to its purification [70] The air of cities would soon be unfit to breathe if it were not changed by the wind. Many good people have become deadened in conscience to a great wrong, as slavery in the old times, and intemperance at the present day; and a great deal of agitation is needed to awaken them and drive away the stagnant, poisonous mental air which is stifling them. As the ocean and earth need agitation to keep them pure, so men need moral agitation to keep their minds healthful, and their perceptions clear. All this agitation comes through the brave spoken words, that are communicated to us by the vibrations of the wonderful harp of many thousand strings located in our marvellous Whispering Gallery.

CHAPTER XXIII.

THE WINDOWS.

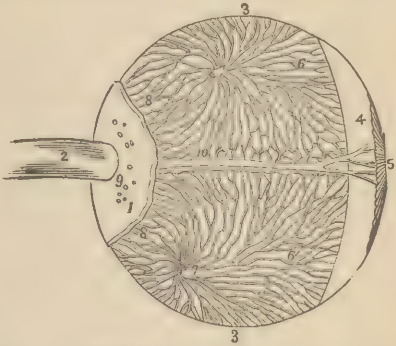
A HOUSE which had no opening for the admission of light and air, and through which the inhabitants could not get a glimpse at the world without, would indeed be a dismal place. You may be sure that the Architect of our House Beautiful never made such a blunder as to forget the Windows. [1] To be sure there are only two of them, but they are so ingeniously constructed that they are able to do the duty of half a dozen. They are located on the [2] front side of the Observatory, under the porticoes made by the arches of the frontal bone. The portico, which protects the [3] stairway used by Aura, the washerwoman, separates these windows one from the other, and also serves as a protection to them. They are still further [4] protected by a bony projection below them. The [5] hollow within these walls is called the orbit of the eye, and [6] the eyeball nearly fills it. [7] Behind the eyeball is a cushion of fat, and around it is a strong fibrous membrane which helps to [8] hold it in place, but not too firmly, for it must be able to turn here and there, and up and down.

[9] The eyes are such very precious and important things that great pains have been taken to keep them

from injury. [10] Each of these beautiful windows has over it an awning which is very movable, [11] and lets itself down over the windows if any danger threatens. These awnings are very delicate, and are [12] trimmed along the edge with a long fringe. [13] This fringe is not altogether for looks, but acts also as a guard, or protection, [14] warning of the approach of intruders, and trying to sweep them away. These awnings are moved up and down by [15] servants, one of whom lets it drop, and another raises it, and all this without noise or rattle of ropes, or any hitch in the working of it which would try your patience. Smoothly [16] they play up and down, during all your waking hours, and when you go to [17] sleep they fold themselves softly over the Windows, keeping out the light and guarding them from harm, until you awaken in the bright, cheerful light of another day. You will recognize these awnings as the [18] eyelids. [19] The Windows themselves are round, not, however, like the little round windows you sometimes see in the cornice of a house, nor like the port-holes in the side of a ship, which are filled with a glass called a "bull's-eye"; but they are round like a ball, and like the home-made balls of yarn, with leather covers, they too, have a firm covering or coat on the outside.

[20] The eye is not a perfect sphere, but is a little longer one way than the other, [21] and its longest diameter is from front to back. [23] The outside covering, which corresponds to the leather covering of the boy's ball, is firm and white, and encloses five-sixths of the eyeball. It is called the [24] *sclerotic.*

It is the white part which we see when we look into the eye, and which we call the [24] "white of the eye." It is *opaque;* [25] that is, it will not let the light pass through it. [26] The other sixth of the eyeball is covered with a transparent coat called the *cornea.* [27] It is not thicker than a sheet of writing-paper, and yet [28] it is even stronger than the sclerotic coat. [29] Transparent not only means that light can pass through it, but that we can see objects through it. If it only permitted light to pass, and we could not see through it, we should call it translucent; but the most perfect crystal, or French plate-glass, is not more beautifully transparent than the cornea.



DISSECTION OF THE EYEBALL.

Showing its second tunic, and the mode of the distribution of the venæ vorticosæ of the choroid. After Arnold. 1. Part of the sclerotic coat. 2. The optic nerve. 3, 3. The choroid coat. 4. The ciliary ligament. 5. The iris. 6, 6. The venæ vorticosæ. 7, 7. The trunks of the venæ vorticosæ at the point where they have pierced the sclerotica. 8, 8. The posterior ciliary veins, which enter the eyeball in company with the posterior ciliary arteries, by piercing the sclerotia at 9. 10. One of the long ciliary nerves, accompanied by a long ciliary vein.

We all like to have beautiful curtains at our windows, and the most beautiful are those which do not obstruct the light. The wonderful windows of our beautiful house are [30] provided with curtains, but in-

stead of being on the inside, they are on the outside of the windows. They are made of a [31] delicate lace-like membrane, which lines the inside of the awnings, [32] both upper and lower, and is doubled back across the eyeball. These curtains have a nicer name, I think, than *madras* or *scrim*. [33] They are called the *conjunctiva*.

The [34] sclerotic and cornea together may be called the first coat of the eye; and [35] the second coat, lying just inside of this, is the *choroid*. [36] It is black in color, so that it will absorb the rays of light, and [37] it covers the same part of the eyeball that the sclerotic does. [38] You can easily see that this leaves a circular opening in front, [39] which is covered on the outside by the cornea. [40] The edges of this circular opening in front, in the choroid coat, are gathered into folds or plaits, which are [41] called the *ciliary processes*. Just [42] lapping over these a little, and joining with the choroid coat, is a very important servant of the eye, known as the *ciliary muscle*. [43] It is a ring of muscular fibres, about an eighth of an inch wide, that [44] decreases the size of the central opening by just its width.

Of late it has become very fashionable to have curtains to doors, as well as to windows, and we give them the fine French name of *portière*; and feel quite proud of them, because we think they are like those of which we read in romances of the olden time. But all this time our House Beautiful has had *portières* more wonderful and beautiful than Persian tapestry, and more delicate even than those of fairy lore. [45] They have a Latin name, *iris*, which means [46] rain-

bow, so that you may imagine that they are very beautiful.

The iris is a circular curtain, [47] and has a round opening in the centre. "Small, is it?" Yes, only [49] an eighth of an inch across; but then [49] the curtain is only half an inch from side to side. It is [50] sometimes gray, sometimes brown or blue, or even olive green, for it must match the rest of the house, you know, and it is generally [51] colored so as to harmonize with the color of the shingles, and that of the outside of the house, which we call the complexion. But it has happened that one of these curtains was blue, and the other brown; and I have seen them where half of one was blue and the other half hazel.

I saw in a paper the other day that it is now not fashionable to have two windows, even in the same room, curtained alike, and perhaps the person who had a different colored iris for each eye was preparing to be in the present æsthetic style. [52] The opening in the centre is called the pupil of the eye, and around this opening, on the inner edge of the iris, [53] is a muscle whose office it is to close the pupil a little when too much light comes into the eye, and around its outer border is another muscle to make the pupil larger when too little light enters the eye.

Wouldn't your mamma be glad if her parlor curtains would shut themselves when the light was coming in too strong on her carpet? [54] We never have to take any thought about these rainbow curtains of ours. They appear to manage themselves.

We have now learned of two coats of the eye, but

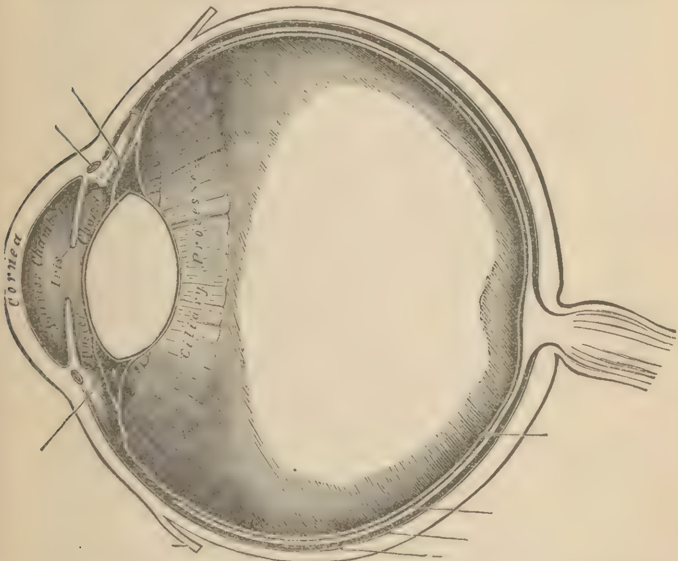
there is still a third, [55] called the *retina*, which we will explain more fully by and by.

But what makes the eyeball? We have thus far had nothing but its coverings. Inside of all these coats is a [58] glassy body, called the [57] *vitreous humor*, a little more solid than jelly, [59] and almost spherical. It would be entirely so were it not [60] hollowed out a little on the front side, much as your rubber ball would be if you were to dent it in, on one side, with your thumb. [61] This hollow comes right behind that part of the eye, which is covered by the cornea and the iris, and in it is placed the [62] *crystalline lens*. You almost know what that is by its name. Crystalline, like very clear glass; and a lens, do you know what that is? A lens is a glass which has the power of making things look either larger, or smaller, than their normal size. A concave lens makes them look smaller, and is shaped like a saucer. [63] A convex lens bulges out like the bottom of a saucer. If you put two convex lenses together you have a [64] double convex lens, and that is what the crystalline lens is.

[65] It is placed behind the pupil, so that all the [66] light which enters the eye must pass through the lens. It is held in place by a [68] transparent circular membrane, called the [67] suspensory ligament. The outer edge of this ligament fits in between those folds of the choroid coat called the ciliary processes, and thus completes the second coat of the eye.

Let us now imagine the eye in place, and see if we can gain a clear idea of its construction. Beginning on the inside, there is first the transparent, jelly-like,

vitreous humor, hollowed out in front to receive the crystalline lens. This vitreous humor is encircled by three coats: the retina inside, the choroid in the middle, and the sclerotic on the outside; each leaving a



SECTION OF THE EYE.

Showing the two chambers of the eye connecting through the pupil. The lens; vitreous humor, retina, and optic nerve.

circular space in front of the crystalline lens uncovered.

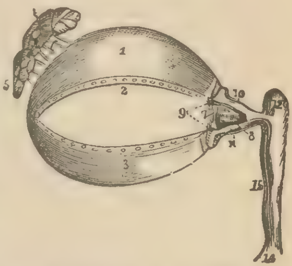
[69] The suspensory ligament which divides to enclose the lens completes the choroid coat. The cornea completes the sclerotic. In front of the lens hangs the [70] circular rainbow curtain, the iris, its outer edge

united to the [71] sclerotic and cornea at their point of union. The iris divides the chamber of the eye into two rooms; one before it called the [72] anterior chamber, and one behind it called the posterior chamber of the eye. You see the cornea bulges out a little, like a watch crystal, so that leaves quite a space in front of the iris. The posterior chamber is made by the curving of the lens from the iris which hangs straight down before it. Both of these chambers are filled with *aqueous* or watery *humor*.

What would you think of windows that would wash themselves constantly, so that they would always be bright and clear? Wouldn't that be a fine arrangement? [73] That is what these windows do for themselves all the time. [74] There is a small ovoid body lodged up under the awning and portico, out of sight, called the lachrymal gland, which secretes [75] a watery fluid. This is the [76] tear gland, and has [77] six or more ducts leading from it. [78] The watery fluid is collected in a little bag, and is always ready for use. [79] A little of it is constantly pressed out upon the eyeball. [80] The awning drops frequently, which we call winking, and this fluid prevents friction of the parts, and at the same time washes off any dust which may have touched the eye, thus keeping it moist and adding much to its brilliancy.

If you will look at the margins of the upper and lower lids, near the nose, you will see a couple of small points. These are called [81] *puncta*, which means points, and they are the openings into the lachrymal canals, which carry off the excess of fluid, after it has

washed the eye. They lead into the nose, and this explains why the handkerchief is often useful when the eyes are disturbed. Along the [82] margins of the lower lids can be found little openings which are outlets for glands which secrete an [83] oily fluid, which is continually poured out along the edges of the lids.



APPENDAGES OF THE EYE.

1. The superior tarsal catilage. 2. The lower border of the cartilage, on which are seen the openings of the Meibomian glands. 3. The inferior tarsal cartilage; along the upper border of this cartilage the openings of the Meibomian glands are likewise seen. 4. The lachrymal gland—its superior or orbital portion. 5. Its inferior or palpebral portion. 6. The lachrymal ducts. 7. The plica semilunaris. 8. The caruncula lachrymalis. 9. The puncta lachrymalia of the lachrymal canals. 10. The superior lachrymal canal. 11. The inferior lachrymal canal. 12. The lachrymal sac. 14. The dilatation of the nasal duct, where it opens into the inferior meatus of the nose. 15. The nasal duct.

You know that water and oil will not willingly associate together, and so the water which comes down to wash the eyeballs keeps away from the edge of the lids because thy are covered with oil. [84] This keeps the water from running down over the cheeks, and so it must go down through the lachrymal canal into the nose, where it will do no harm. Sometimes, however, this canal gets stopped up, and then the fluid must flow over the cheeks, and we then call it tears. If it continues long the checks will [85] become sore and painful, and look bad, and the eyes too will get sore. There are times when from some emotional excitement, as when there [86] is sorrow or grief, the glands

which supply the tears are pressed upon so hard that the tears flow in great quantities over the cheeks, and this we call crying, or weeping. Did you ever think of it, that while animals seem to feel sorrow for the loss of their young, [67] man is the only animal that can weep over the sorrows of others? He alone can shed tears of sympathy, and he alone can feel the relief from such an expression of sympathy from others. A child related to her mother how she consoled a companion who mourned the death of a brother: "I could not say anything, but I put my head down by hers and cried with her, and she felt comforted."

We should be thankful that we are able to weep with those who weep, as well as to rejoice with those who rejoice. Our beautiful windows will shine all the brighter because they have been washed by the tears that have fallen for others' woes.

CHAPTER XXIV.

THE DOUBLE TELESCOPE.

In the midst of the millions of nerve-cells which fill the dome, which we have styled the Observatory, sits the master of the house, the [1] Man Wonderful, in darkness, and in a silence broken only by the gentle whisperings of that wondrous many-stringed harp, the organ of Corti. Light never enters his seclusion, he [2] never ventures forth from his narrow abode until he quits the House Beautiful forever. Shut in as he is, he, [3] however, does not remain ignorant of the outer world, for over his complicated telegraph system he is constantly receiving messages concerning everything that is around him. [4] Originating among these nerve-cells are twelve pairs of nerve-cables. [5] These constitute the cerebral nervous system.

[6] We have learned how through his Telegraph system he becomes acquainted with himself, and to some extent with the outer world; [7] but by far the greater part of his information, about things outside of himself, which the German style the "Not me," comes to him over the nerves which connect with the Telescopes. [8] The great importance of these Telescopes is indicated by the fact that the second, third, fourth,

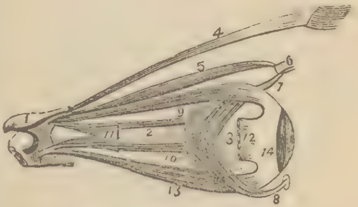
and sixth pairs of nerves and one of the three branches of the fifth pair are all employed in the transmission of messages to and from them.

You all know what a telescope is, [9] an instrument so made that you can look at distant objects, at different distances, by lengthening or shortening its cylinder. In observatories the telescopes are so [10] large and heavy, that ropes and pulleys are necessary to change the position so as to see different objects. [12] If such a telescope were endowed with the power to change its position and lengthen or shorten its tube just when it was needed without any direction from the owner, it would be considered a marvel of skill; but how much more marvellous would it be if there were two such telescopes which, having such power, should work always accurately together.

[11] It is such a pair of Telescopes that is used by the Man Wonderful in the House Beautiful. Through them he receives the greatest amount of his information, [12] and you know them as the eyes. [13] Each eye is moved by six muscles. When the eyes are directed to one side, an external muscle of the one eye and an internal muscle of the other work together. One muscle is particularly worthy of being named, as it works over a pulley. [14] It is called the *superior oblique* and is attached to the upper part of the eyeball, [15] and its action, in connection with its fellow, the inferior oblique, is to rotate the eyeball. The most [16] important of the nerves which go the eyes are the optic nerves. They have their [17] origin in the cells in that portion of the brain known as the

corpora quadrigemina. [18] Coming forward from either side of the brain they cross each other like the letter X. The point where they cross is called the *optic commissure.*

It is of the greatest interest to remember how the nerve threads or fibres are distributed and arranged within this optic commissure. First, [19] some fibres go



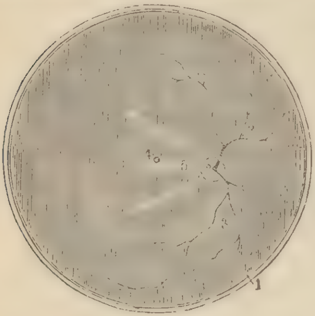
MUSCLES OF THE EYEBALL.

View of the ocular group, taken from the outer side of the right orbit. 1. A small fragment of the sphenoid bone around the entrance of the optic nerve into the orbit. 2. Optic nerve. 3. Globe of the eye. 4. Levator palpebræ muscle. 5. Superior oblique. 6. Its cartilaginous pulley. 7. Its reflected tendon. 8. Inferior oblique. 9. Superior rectus. 10. Internal rectus, almost concealed by the optic nerve. 11. Parts of the external rectus, showing its two heads of origin. 12. Extremity of the external rectus at its insertion. 13. Inferior rectus. 14. The tunica albuginea, which is formed by the expansion of the tendons of the four recti muscles.

from the right to the left side of the brain; second, some go from the right side of the brain to the left eye; third, some go from the right side of the brain to the right eye; fourth, some go from the right eye to the left eye, and all pass through this optic commissure.

The same arrangement is true of the fibres which start from the left side of the brain. [20] These fibres all enter the posterior or back portion of the eyeball, through one opening. Once inside of the eyeball, they spread out and connect with the [21] cells of the retina, each fibre ending in a cell. [22] Reviewing the connection of the eyes with each other and with the

brain, we see that a nerve-fibre goes from a cell in one eye to a cell in the other; that a nerve-fibre goes from a cell in one eye to a cell in each side of the brain; that a nerve-fibre goes from a cell in one side of the brain to a cell in the other side of the brain.

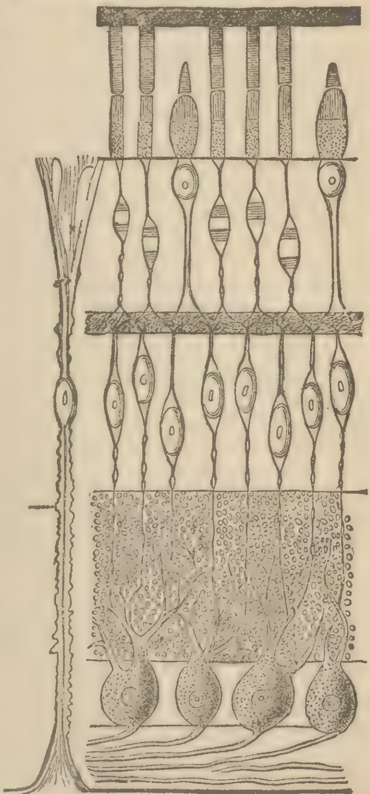


POSTERIOR SEGMENT.

The posterior segment of a transverse section of the globe of the eye, seen from within. 1. The divided edge of the three tunics. The membrane covering the whole internal surface is the retina. 2. The entrance of the optic nerve with the arteria centralis retinæ piercing its centre. 3 3. The ramifications of the arteria centralis. 4. Foramen of Soemmering, in the centre of the axis of the eye; the shade from the side of the section obscures the limbus luteus, which surrounds it. 5. A fold of the retina, which generally obscures the foramen after the eye has been opened.

[23] It would not be possible to connect the eyes more intimately. [24] At the point where the optic nerve enters the eye, light makes no impression upon the retina, and it is called the blind spot. [25] About one-eighth of an inch external to the entrance of the optic nerve, is the central axis of the eyeball, and at this point there is [26] an oval spot. Its horizontal diameter is [27] one-eighth of an inch, its vertical diameter is one-thirty-sixth of an inch. [28] It is called the yellow spot of Soemmering. [29] In the centre of this spot is a depression known as the *fovea centralis.* This depression is exactly in the centre of vision. It is this little point which catches the light from the centre of every object that we look at. [30] The optic nerve forms a layer of the retina, that, at the [31] yellow spot of Soem-

mering, is not more than one-fifty-thousandth of an inch in thickness, [32] but becomes progressively thicker from this central point to the periphery of the retina. [33] Resting upon this are nerve-cells which, at the yellow spot, [34] are eight layers deep, but which grow progressively thinner, so that at the periphery there is but one layer of cells. [35] These are known as the ganglion cells. [36] Each one sends a filament to the layer formed by the expansion of the optic nerve, which is continuous with the nerve-fibre. [37] These ganglion cells send out filaments in the other direction which go forward, through different granular layers [38] and corpuscles, and connect with the rods and cones which form the [39] first layer of the retina. [40] These rods and cones are minute slender cyl-



The internal limiting membrane of the retina is seen at the base. The four rounded bodies above are in the vesicular layer.

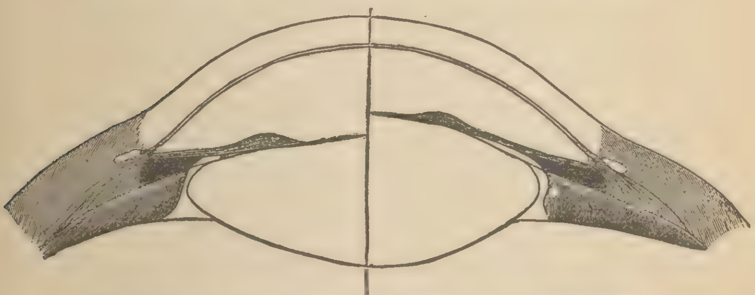
inders, standing with a free end pointing toward the centre of the eyeball. [41] Light in entering the eye strikes first upon the ends of these innumerable needle-like bodies, and through them the [42] impression is transmitted to the eighth coat of the retina, which is the first one we examined, and is the expansion of the optic nerve. When the light from the centre of an object does not strike directly upon the centre of the eye, which we have learned is the yellow spot of Soemmering, [43] the eye involuntarily changes its position in order that the light may be received upon the centre of this spot, the *fovea centralis.*

[44] In order to effect this change a message must be sent from the eye through the optic nerve to the cells in the brain. [45] This message must be transmitted through the third, fourth, and sixth pairs of nerves [46] to the muscles which control the movements of the eye. Then the eye is properly adjusted. All this is done without the knowledge or direction of the master of the house.

[47] Whenever too much light enters the eye a message must, in like manner, be sent to the brain and word received in return for the muscles to contract the opening in the iris, and make the pupil smaller. [48] When the object is too near, or we wish to see more distinctly, a message is sent to the brain, and an order received that the [49] ciliary muscles shall contract, and thereby make the crystalline lens more convex, and bring into action the microscopic powers of the eye. [50] Such messages as these are constantly being sent, and perhaps many of them at one and the same time,

and all these changes go on harmoniously, both eyes acting exactly alike. If the master had to take thought of the movements of his eyes he would have little time for anything else.

We have studied the outside of the eye and have admired those beautiful windows with their rainbow-colored curtains, with lace ones over, and the delicate fringed awnings for protection; but if we take a glass



SECTION OF THE LENS, SHOWING THE MECHANISM OF ACCOMMODATION.

The right side of the figure shows the lens adapted to the vision of a near object; the lens is thicker. The left side shows it adapted to vision at infinite distances. —(FISK.)

called an ophthalmoscope and look through the pupil into the eye, we shall find that all its beauties are not external.

[52] The artery which supplies the eye enters with the optic nerve. [53] It divides and subdivides, and spreads out upon the retina like the branches of a beautiful scarlet vine trained against a wall, and the [54] light reflected from these gives the whole eye a delicate pink hue, a picture not revealed to ordinary gaze, but none the less of incomparable beauty

What is light? I can not answer this question. I know that light passes through transparent glass, but I can not comprehend it. But we are taught that it is a mode of motion. Another mode of motion is heat. We know that [55] light passing through the air creates caloric or heat. When it passes through glass the heat is increased. If, then, where the medium has more density there is more heat, are we not justified in believing that it is friction which causes heat? And if there is friction must there not be something to cause friction?

We can see and feel the effects of waves of water. We can not see, but we can feel, the effects of waves of air. We can also weigh the atmosphere and know that we have a pressure of fifteen pounds to the square inch. But here is a something which we can neither see, feel, nor weigh. Can we in any way demonstrate that it has power? [56] Analysis shows that it has rays of light and heat, as well as chemical rays. We know that it causes plants to grow, and a machine has been constructed, called a [57] radiometer, which, placed in a vacuum, runs simply by the force of the rays of light. [58] Light has been analyzed and found to be compounded of the colors of the rainbow. And it has been found that [59] the color of light is determined solely by its wave length. [60] The length of a wave of red light is about one-thirty-nine-thousandth of an inch, and that is the longest wave. [61] Light travels at the rate of 192,000 miles in a second. We have only to multiply this distance by 39,000 and we will have the number of red waves of light that will

strike the eye in a second. And this makes about 474,000,000,000,000 (four hundred and seventy-four trillions) of red waves that strike the eye in a second.* These multitudinous waves striking against the ends of the rods and cones, and through them transmitted to the brain cells, produce the sensation known as light.

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* Tyndall.

CHAPTER XXV.

TWIN-BROTHER GUARDIANS.

POLITENESS requires that when we visit our friends, we should rap at the door, or ring the bell, and wait to be admitted. If we are calling upon a stranger, we are often requested to state our business before we are permitted to see the master of the house. There must then be certain persons whose employment and duty it is to scan those who desire admittance to the dwelling, and state what is the pleasure of the master. These persons might well be called the Guardians of the house. If the grocer's boy comes with food, it is accepted, unless it is not what was ordered or is in some way defective. The servants are apt to form their judgments from their own personal likes or dislikes, and their opinion may not always be correct. Yet the master of the house must rely upon their judgment to some extent, or the servants will be of little use to him.

It is not to be expected that a house so valuable as our House Beautiful would be left unguarded. There are several guards stationed in different parts of the house who watch over its welfare. [1] One of these is stationed in the lower front hall. [2] He is a

soft, smooth, supple individual, and wears a pink uniform, and, like all the servants of this [3] house, is never allowed a day out. He is ever on duty, though he often puts his head outside the door to take a peep at the world. He is so soft and nice when you please him, that you might fancy that he could never be cross; [4] but if he does not like people, he never hesitates to say so, and he turns them out of the house at once. [5] Sometimes, on a long acquaintance, he becomes attached to those who at first were very disagreeable to him.

THE TONGUE.

The tongue and its papillæ are shown. 1. The raphe, which sometimes bifurcates in the dorsum, as in the engraving. 2, 2. Lobes of the tongue; the rounded eminences on this part of the organ and near its tip are the fungiform papillæ; the smaller papillæ, among which the former are dispersed, are the conical and filiform papillæ. 3. Tip of the tongue. 4, 4. Its sides, on which the papillæ are arranged in fringed and lamellated forms. 5, 5. The A-shaped row of papillæ circumvallatæ. 6. Foramen cœcum. 7. Mucous glands at the head of the tongue. 8. Epiglottis. 9, 9. Fræna epiglottidis. 10, 10. Greater cornua of the hyoid bone.

You [6] have not forgotten that repairs are constantly going on in our house, and that nearly everything needed to build it up is brought to the lower front door. [7] Here it is examined by this guard, who decides whether it suits him to let it pass or not. [8] He can not always make a final decision, but submits the matter to the owner of the dwelling for his opinion. [9] "This tastes good," he says, "I think you bet

ter let it pass"; or, "This does not taste good, I would rather you would not admit it." The owner likes to please this guard, who has the rather long name of [10] Gustatory Sense, and generally refuses to admit those whom Gustatory Sense dislikes. But there are times when he must decline to be guided by the opinion of another, and must decide by his own reason whether the article shall be admitted or not.

[11] Gustatory Sense is such a long name, that he is generally called Taste. [12] Taste has to be carefully watched. He does not always know just what is needed in the house, and makes his decision from his own personal likings. [13] He is fond of sweets, and sometimes sends so much of them into the kitchen, that the cook complains that he can not dispose of them, and, by and by, perhaps the other assistant cooks get soured with being [14] overworked in digesting so much sweet, and they rebel and say, "We will not have it," and they call in some powerful muscular servants to aid them, and they send the [15] offending substance back up the kitchen stairs and out at the front door, [16] and Taste does not like that at all. He never relishes anything after the cooks have been working at it.

[17] If the muscles are not sufficient to send out the offending material, the owner of the house may call in a helper, whose name is designated by the two letters, Dr.; [18] and he gives something which Taste would gladly put out of the house at once, but he is compelled to let it pass, and when it gets into the

kitchen, it causes such a great disturbance, that an extra effort is made to get rid of this new intruder, and, in the accomplishment of it, the [19] obnoxious sweet is also sent out, and poor Taste feels that he has a hard time of it. You [20] would think that he would learn by this experience to avoid that mistake again, but the truth is, that when he has once acquired a liking for a substance, he will accept its company, no matter how much trouble it may cause in the house.

[21] It is, therefore, important not to allow him to make objectionable acquaintances, for he may become so intimate with them that he becomes very unhappy unless he can have their constant society. [22] Unfortunately we can not discharge him, although he may make us a great deal of trouble or even pain. We can only take charge of him, and [23] not allow him to become master of the house. [24] He will grumble very loudly, and complain that he is very miserable because we do not trust him, and sometimes he induces other servants to join in this fault-finding; the only way then to do, is not to listen to any of them, but give them to understand that [25] Reason, not Taste, is master; and when he has been taught, by Science or Experience, that certain things are harmful, we will listen to his advice and not to that of Taste, who selfishly, at such times, cares only for his own pleasure and not for our real good.

[26] When people live in a simple and wholesome manner, the judgment of Taste is usually to be trusted. [27] He will always say that milk is good, that he likes

plain bread and butter, and simply-cooked vegetables and meats. But [28] if he is accustomed to having everything dressed up very fine for his pleasure, he loses the ability to judge of the worth of honest, wholesome, plainly-dressed visitors, and decides that he prefers appearances to reality. [29] He is quick to be educated in wrong habits. So it is very important that we should be careful to give him a good education. [30] I have seen little people whose Gustatory Sense said that he would not admit bread into the house unless it wore a coat of sugar or honey, and as papas and mammas know bread is very necessary to life, they sometimes think that they will be [31] obliged to listen to the demands of Taste, or the little beautiful house will get out of repair. [32] So in order to get all of the substances needed for repairs, the cooks are obliged to dispose of too much of something not needed.

If, when [33] he insists upon having all of his company dressed up, he were deprived of all company for a while, he would be very much pleased to receive a call from a piece of very dry bread, and would say, "O, how good that tastes."

There are several bad habits into which Taste may fall. He [34] enjoys "good things" so well that he often gets into the habit of tasting too frequently. He is not satisfied with what he gets at the table, but he must be tasting between meals, and this creates a great deal of trouble in the house. [35] The cooks get out of patience because he keeps them all the time at work, so that they get very little chance to rest, and

no one likes to be always working hard. But, [36] if Reason does not govern this little fellow in the pink uniform, instead of being our guardian, he becomes our destroyer. Sometimes he is not content to eat a fair amount at meal-time, but calls for more and more until he fills his poor kitchen so full that it [37] can not

FILIFORM. FUNGIFORM. CIRCUMVALLATE.

THE THREE KINDS OF PAPILLÆ OF THE TONGUE MAGNIFIED.

The fungiform termination of nerves is found on the end and border of the tongue; the filiform on the middle, and the circumvallate on the back portion of the tongue. An artery and vein can be seen going into each papilla; the artery is farthest to the left.

squeeze together, and the master is made to feel very uncomfortable, to say the least, and often he is caused to suffer pain and disease. [38] Another bad habit is to call for food so fast that the owner is obliged to eat as fast as he can, to gratify Taste's desire to feel some thing good passing over him all the time. [39] This is the cause of indigestion, because [40] food that is swal-

lowed so rapidly can not be well masticated, and that makes more work for the cooks, and the result is that they can not do their work well, [41] and so the house is not well repaired. [42] If Taste did but know it, he would enjoy much more to let the food stay longer in the mouth, and turn it over and over, chewing it well, and so obtain a full taste of all the sweetness.

[43] A very common bad habit of his is desiring all food to be rich in quality, full of sugar or fats or spices, all of which he soon acquires a taste for, and says things are poor and not good unless containing a large quantity of these things. He makes a mistake in calling them good, for they are [44] not good, unless they are needed to keep the house in repair or to keep it growing. If we desire that Gustatory Sense shall be truly our guardian, we must keep him from acquiring these bad habits, or he will in time become our master, and a very tyrannical master he is, I assure you.

CHAPTER XXVI.

THE OTHER TWIN-BROTHER.

[1] ONE of the guardians of our house makes his home in the upper part of the winding stairway used by Aura in going to the laundry,—we might say in the third story. [2] A German, named Schneider, first discovered his hiding-place in a [3] pink membrane, which is therefore called the Schneiderian membrane. [4] Gustatory Sense presides over the foods and drinks. He is a very good guardian, but he [5] can not examine those companions of Aura who go in by the winding stairway, and he is therefore assisted by his [6] twin-brother, Olfactory Sense, called familiarly Smell.

[7] Aura, whom you will remember as a washerwoman, is also a very important and helpful person, but, like some others, has relatives whom we can not altogether trust, for she is related to the [8] Gas family, some of whom are very dangerous. You will remember that [9] carbonic acid gas is such a deadly foe to life that it is constantly being thrown out of the house. [10] Some of these dangerous gases Smell always detects, and notifies the master of the approach of harm. [11] Aura, although a relative of the Gases, and intimate with them, is nevertheless always trying to prevent them

from doing harm, and acts as a peacemaker between them and us. If you go into a cellar that has been shut for a long time, Smell tells you that a bad air has accumulated there. [12] Open the window and admit Aura; and she, [13] true to her nature, begins to purify and cleanse the place, and render the bad air harmless. There are circumstances in which Smell is not able to do his duty in detecting the foes of the household. One of these is [14] when connection has been cut off between him and the master, as is the case in a bad cold. [15] At this time we also find it difficult to tell the true taste of foods. Indeed it is often difficult to decide whether the idea we have of a substance is formed from the opinion expressed by Taste or Smell, they are so closely related. That which we suppose to be the flavor of onions or garlic is in reality their odor.

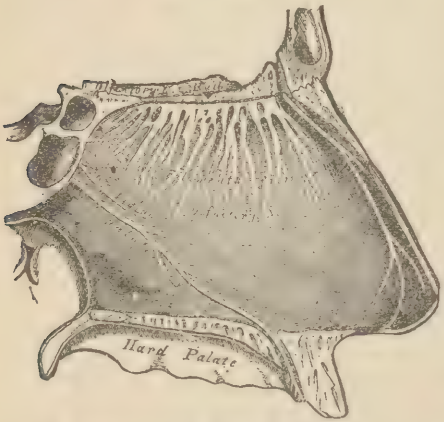
Sometimes [16] Smell seems to have lost his conscience, and associates with bad odors without saying anything about them. [17] If you sleep at night with doors and windows closed, in the morning you wake up not feeling rested. But Smell says nothing to you of bad air. He has been associating with it all night, and has got accustomed to it. But go out into the fresh, clear morning air for a brisk run, and then return to your room, and then Smell suffers a spasm of conscience, and exclaims: "O, [18] what a dreadful atmosphere; I can not endure it." Then he continues, in quite a dictatorial manner: "Don't you know that you have been washing your blood in this air for hours? Do not breathe it over again. It is poison. You

have nearly smothered me already. I shudder to think how you have been compelling me to smell, all night long, the [19] waste matter which your body has been casting off. [20] You would not drink water which you had used for washing your clothes, or even your faces; yet that is cleanly compared to breathing, again and again, the air that has been used for washing your blood."

When Smell does wake up, he is apt to be pretty severe in his scoldings, and more than that he is right, too. "But what shall we do? We must breathe at night." That is true, and we should be careful to admit plenty of fresh air to breathe. Don't be afraid of night air in your bedrooms. It is all the kind of air you can get at night, and to have it coming in pure and fresh is far better than to be shut up with a small quantity, and breathe it over and over again. It is not necessary that you should have a [21] draft through; if you only have an opening somewhere the air will be constantly changing. We can prove this by experiment.

Most gases are lighter than air, and consequently have a tendency to rise. [22] When we fill a cup with them we have to turn it bottom up so as to hold them. [23] But carbonic acid gas, the gas which is being thrown off from the lungs constantly, is [24] heavier than air, and can be put into a cup that is right side up. It can be poured from one cup into another, just as water can, and we prove this by [25] putting a lighted taper into the cup. If it be full of carbonic acid gas the light will not burn, and a gas which is so

deadly to light is equally deadly to life. [26] Although this gas is heavier than air, if we leave a cupful of it standing open we shall find, after a time, that it has climbed out of the cup, and diffused itself throughout the air of the room; so, although it sinks to the bottom of our bedrooms, yet if we leave an opening somewhere it will climb out, although it would be better if the opening were near the floor.



Nerves of the Nose—Right Side.

Nerve of special sense spread out through the Schneiderian membrane.

To become acquainted with the smell of a substance, the nerve of the [27] Schneiderian membranemust come in contact with some of its particles. [28] How very small these particles must be is shown by the fact that a grain of musk perfumed a room for nearly forty years without losing any appreciable weight. [29] In cases of contagious diseases, the germs of that disease are floating through the air and sometimes Smell can detect them, although none of the other senses can recognize their presence. We often think that if we have covered up a disagreeable odor by a pleasant one we have remedied the trouble. This is

a mistake. A handkerchief saturated with attar of roses might prevent Smell's detecting the odor of perspiration, but it would not have been removed by the perfume. Nothing would do that but a bath. [30] In the same way many of our so-called disinfectants only cover up poisonous odors. They do not remedy the evils. The best and only perfectly effectual disinfectant is [31] oxygen, Aura's powerful washing preparation.

Olfactory Sense is not only a guardian, warning of danger, but he also gives pleasure to the master of the house. He does this partly by the assistance which he gives to Taste in appreciating the good qualities of foods; he has also the power to communicate many pleasant things himself. He understands the language of the flowers, and interprets the sweet whisperings of the lily and rose, and of the aromatic balsams and pines, and repeats over and over again the dying song of the new-mown hay.

Even he whose ears are closed to melodious sounds, whose eyes are sealed from glimpses of blue sky and all the wonders of earth, is not altogether comfortless, for the wonders of air can yet be revealed to him, and through this faithful friend and guardian he can be protected from some evils and cheered by some blessings that come to him,

> "Like the sweet south that breathes
> Upon a bank of violets
> Stealing, and giving odour."

CHAPTER XXVII.

THE FAÇADE.

EVERY child has noticed the fanciful resemblance between the front of a house and the human face. That child surely did, who seeing a fringe of icicles along the gable asked, "Mamma, who banged that house's hair?" [1] The front of a house is called the façade, and that means the house's face. [2] The façade is usually more finished than the other sides of the building. [3] It may be ornamented with columns and arches, or decorated with carvings, and statues, and sculpture, so as to become a work of art; to see which people will travel across seas, and to remember which will be a joy forever.

James Ferguson, in his History of Architecture, says: "It may be safely asserted that a building is beautiful and perfect, exactly in the ratio in which the same amount of concealment and display of construction is preserved, and where the same symmetry is shown as between the right and left sides of the body. In short, there is no principle involved in the structure of man which may not have been taken as the most absolute standard of excellence in architect-

ure." Is not this a proof that we have wisely called our body the House Beautiful? It is often difficult to tell what it is that makes an object beautiful. [4] It is not any one thing, but a union of many qualities. In the highest works of nature we find symmetry a most striking quality. [5] In man this symmetry is very marked. Each outside half of the body is like the other half.

[6] Many people think that a thing is beautiful if it is useful. It is true that when nature makes any of her works more useful, she at the same time makes it more beautiful. To ornament the outside merely, without adding something practical, is not to make a thing beautiful. [7] We might think that the foundations of our house were not beautiful, but they are useful, and more than that, they add to our grace and dignity. The very way in which the skeleton is put together makes the outside of the house look well, and enables one to walk with grace. "The cat and deer can not move inelegantly. The dancing-master can not teach a badly built man to walk well." You will be better able to appreciate the grace and convenience of the foundations, if you imagine that the bone of the arm might have been made square, with sharp corners, and bolted on at the shoulder. Study the formation of the whole body. [8] See how beautifully the ribbon-like muscles taper down to the tendons which are inserted into the bones, giving that charmingly graceful outline which all admire. See how noiselessly they play against each other under the flexible, elastic walls. [9] A statue can give us the same

beauty of outline, but it can not give us beauty of motion.

[10] The beauty of the human form arises from its being suited to the needs of the master. [11] Did you ever read of a world of chance? I have, and in that world things happened, having no intelligence to direct them, as in this world which God governs. Men's bodies grew in strange fashion. Sometimes the arms were square, and the shoulders like a flat-iron. Sometimes the bones were solid and as heavy as lead. Perhaps the head was the shape of a tea-box, while one ear was on the back of the head, and the other upon the forehead. One eye was in the middle of the hand, and the other under the arm. I fancy that no one of us would like to live in such a world, nor would we find much to admire in a house so badly and irregularly constructed. [12] One ought surely never to find fault with their bodies, so beautifully contrived, and made, as it is said, in the image of God. To be beautiful, things should be appropriate. What is very pretty in one thing is not at all pretty in something else. [1] The peaceful shepherd watching his flock in the field does not need the strength and muscular development of the warrior.

We would not be pleased to see the proportions of a man, which signify [14] energy and vigor, given in exchange for the roundness and delicacy of the womanly form which especially typify grace. We even expect and admire a different form in youth from that of age. [15] In boyhood we look for activity and swiftness; in manhood, for dignity and strength

[16] In the wrestler we examine the strength of the arms; in the racer we look at the development of the legs, and call each beautiful when we see that the body is adapted to its work.

[17] But this fitness for its special work is not enough to account for all of our admiration for the House Beautiful, the human form. We must add something which we can not see, or touch, and yet which makes itself felt. [18] This is the character of the inhabitant. "Every spirit makes its own house," says Emerson.

If the man who lives in a house is its builder, we can form something of an opinion about him. [19] So we can tell something about the Man Wonderful who dwells in our House Beautiful by looking at its outside. [20] We can tell whether he is gay or sad, whether he is strong or weak, whether he is old or young.

When we see [21] a tender babe we think of innocence and helplessness. The figure of the lad or youth indicates hope and activity. That of man indicates strength, thought, and courage. That of woman, delicacy, modesty, and tenderness.

But to be wholly beautiful there must be a [22] unity of design. That is, things must seem to belong together. As a philosopher puts it, "Short legs, which constrain us to short, mincing steps are a kind of personal insult to the owner, and long stilts put him at a disadvantage, and force him to stoop to the level of mankind."

But, [23] do we ever speak of the beauty of a person whose face we have not seen? What makes the features of the countenance of such great importance?

[24] It is by the expression of the face that we judge of character. We form an opinion of the spirit by the façade of its house. There can be no beauty which does not seem to mean something. [25] We even talk of things that have no life as if they had mind. We say the elm expresses protecting strength; the vine, clinging weakness. We speak of the flaunting dahlia and the modest violet, as if their peculiarities were the effect of thought, or the expression of character.

It is a fact [26] that a certain feeling will give a certain expression to the face, and it is true that an expression of face will, often, create a corresponding feeling. Try it. [27] Frown and pout and you will find your mind taking on the feelings which your face expresses. Smile, put your face into the expression of gentleness or mirth, and it will be next to impossible to be cross or angry.

The [28] attitudes of the body are also indicative of different feelings. It has been claimed that every feeling which can be expressed by [29] language can also be expressed by gesture and attitude.

In pantomime a whole story is told without a spoken word, by gesture and action alone. [30] Statues which were chiselled hundreds of years ago tell their story of joy or grief to us, as plainly as they did to those who created them, or who first looked upon their almost speaking figures and faces.

Public speakers know the force of [31] gesture. An audience may be convulsed with laughter simply by a grimace, and how much can be said by the human hand. It beckons to approach, it warns off, it de-

fends, it threatens, it entreats, it caresses, it blesses. [32] Much of the beauty of the Façade depends upon the form of the head, the proportions of the three divisions of the face: the curve of the eyebrows, the character of the nose, the size and form of the mouth· the roundness or squareness of the chin and jaw, and the manner in which the head is set upon the shoulders. [33] These features, when the eyes are in repose, will always have the same expression. [34] But the general expression of the face changes under the influence of strong feeling.

We may see [35] the brow contracted with anger or pain; or the eyebrows raised in attention, or admiration, or astonishment. [36] But it is in the eye that the feelings are most clearly revealed. The man looks out of his windows and we see [37] his thoughts. We need no words to tell us that he is angry, or sad, or happy. He can tell his thoughts in words, but in spite of himself, often, they are written on his face and figure. [38] Attitude and gesture are the unspoken language by which the face and form express the character and feelings of the mind. But the attitude which may be admired in one will not always awaken the same feeling, if seen in another.

[39] The gestures and tones of the minister, in the pulpit, may awaken our admiration, but when closely imitated by a little child will only cause a smile.

In the [40] coloring of our house there is a unity. The eyes, hair, complexion, the eyebrows, all have a correspondence and a meaning.

We judge of temperament, tastes, and characteris-

tics by this coloring, and we have an opinion whether there is a healthy body by the color of the skin.

"It is the soundness of the bones that ultimates itself in a peach-bloom complexion; health of constitution that makes the sparkle and power of the eye."

[41] The color of the face changes with the feelings. Joy brings a charming glow, modesty gives a delicate flush, while [42] anger dilates the capillaries and surges the cheeks with a dark, unlovely red, or it contracts the capillaries, and the cheeks grow deadly pale. "He was white with rage," we sometimes say. And this is a more deadly form of that baneful passion than that which covers the face with a glow.

[43] But color, like expression, should be appropriate. The color of the baby is not pleasing on the face of youth, nor the complexion of man charming on the face of woman. [44] Ruskin says we do not appreciate the sacredness and nobleness of color. "What would the world become," asks he, "if the blue were taken from the sky, the gold, sunshine and verdure from the leaves, the crimson from the blood which is the life of man, the flush from the cheek, the darkness from the eye, the radiance from the hair? If they could see, but for an instant, white human creatures living in a white world, they would soon feel what they owe to color. Of all gifts to man color is the holiest, the most divine, the most solemn. . . . . And the purest and most solemn minds are those which love color most."

This is a consoling thought. We all desire to be

beautiful, and color is an element of beauty. [45] Health gives the most charming tint, and health is largely within our grasp if we obey the laws which have been made to govern our bodies. [46] No matter how irregular our features, if lighted up by the glowing hues of health, they will have a charm. Add to this the beauty of expression, the shining out of a noble spirit, and we can well spare mere beauty of outline. The beautiful soul transfigures the plain face. Artists say, no face is perfectly symmetrical; the nose is not in the middle, the eyes not exactly equal. But what does it matter if the spirit has high ambitions, thinks great thoughts, plans great deeds to benefit mankind. "'Tis no matter whether his nose is parallel with his spine, as it ought to be, or whether he has a nose at all, whether his legs are straight, or whether his legs are amputated," says the philosopher Emerson. [47] Beauty lies then in our own hands. We can make our house what we will. Face and figure may tell of low, base thoughts that mar the most perfect features, or they may portray gentleness and love, or grandeur of thought and ambition that will ennoble the plainest face.

[48] Pausing before the façade of St. Peter's at Rome, or that of the beautiful cathedral at Milan, with its 5,000 marble statues, or that of the most perfect of all cathedrals at Cologne, with its magnificent towers and Gothic architecture, you will be hushed with admiration and awe. You will marvel at the skill of those who planned and builded such masterpieces, and then you will remember that they are dead, and

the works of their hands are gradually crumbling into decay. [49] But the House Beautiful can grow more and more lovely while the inhabitant every day and hour carves with delicate skill some fine tracery upon its walls, or moulds more clearly the lines which show a divine beauty and harmony.

[50] Truly no work of man's hand can equal this beautiful house, the work of Divine Wisdom; and we ought to praise Him, that in spite of all inherited defects of constitution or configuration, we can, by the aid of His will working in us to do His pleasure, remould our features into an expression of divine beauty.

If we study to know the construction of this our wondrous dwelling-place, and to learn the laws which govern its workings; if then with religious care we obey every law as it has been revealed to us; if we keep from our minds all unlovely feelings, all ungenerous emotions, and respect ourselves as the creations of God's skill, and therefore holy, and to be sacredly guarded and cherished; if we entertain only those nobler thoughts, those worthy ambitions whose moulding touches trace in ever deepening lines upon the face an expression of immortal excellence, we shall be rewarded with the physical health which gives beauty of outline and coloring, with the vigor which is expressed by vivacity and strength, and with those spiritual graces which add beauty of expression, and then, and not till then, will our bodies, in the highest sense, be "Our House Beautiful."

PART II.

THE MAN WONDERFUL

CHAPTER I.

THE BABY.

[1] OUR House Beautiful is finished. From foundation to cupola it is complete. We have gone through its various rooms, have examined their construction and purpose. [2] We have admired the wisdom and skill that planned and created so marvellous a dwelling. [3] But, as we look at it, we see that the windows are closed, the house is still. Where and who is the tenant? You will never see him. Will the house then never be inhabited? [4] Oh, yes; but you will never see the inhabitant. [5] You will catch glimpses of him peeping out of the windows; you will hear him speak, and he will hear you; [6] you will become acquainted with his likes and dislikes, and, through his actions, with his motives and thoughts; you will see him carry out plans which he has made; you will please or offend him; you will love or dislike him; but you will never see him.

[7] The Man Wonderful who is to live in this House Beautiful [8] is a more marvellous study than is his

dwelling. He will take possession of it, and little by little we will become acquainted with him. [9] When first he comes to dwell in the house, he is a stranger to himself, his home, and to the world.

His house is very small, and not altogether complete; [10] for there are no white soldiers to receive his visitors, and in his dining-room certain attendants are wanting. His guardians of the Sense family are not at all educated; [11] his hundreds of muscular servants are untrained; and he [12] is incapable of giving them any commands. [13] At times the windows are opened a little, but the Man does not seem to look out of them. [14] Only the folding-doors seem to be in perfect working order, and, judging from the sounds that issue forth, the Man Wonderful is principally a voice.

[15] No young creature is so perfectly helpless as the human baby. [16] Calves and colts can run as soon as born, and the chick of the hen or quail will often run with the shell on its back. [17] But the infant Man, if left to himself, must inevitably perish. [18] He can not seek his food; he can not even turn himself over unaided; and for months he can not move himself from one place to another. [19] He is simply a brute, and superior to all other brutes only in his vocal powers. They are his only [20] prophecy of greatness. Very slowly he will gain possession of his powers, but by and by he will develop that which will make us ashamed that we have called him a brute.

[21] It was doubtless the design of the Architect that the House Beautiful should be inhabited until it grew old and gradually fell into decay. Then the Man

Wonderful was to vacate his dwelling and move into the "House not made with hands, eternal in the heavens."

[22] But, too often, the house is vacated by its infant tenant before it has had time to reach its full development. [23] We may find some apology for this, because nature has made the young of the human race so helpless. [24] But man has the advantage over brutes, in that he has reason and should be able to study the laws of the body and obey them, and thus largely [25] prevent premature vacation of these little houses.

[26] The first need of the body is clothing. [27] The woollen garment of the lamb is a model one. It fits perfectly; it is not too tight; it does not bind the body in any place; it does not interfere with entire freedom of limbs; it is soft, and loose, and warm; there is no superfluity of material. These are the qualities needed in the clothing of the infant. [28] Bands that restrict the use of arms, or legs, or stomach, are as bad for the baby as they would be for the lamb. Babies are made to live and be happy, [29] and are always as happy as they are permitted to be. [30] If they are unhappy, it is because something is wrong in their dress, their food, or the circumstances which surround them.

[31] We all know that there are persons whose very presence does us good, and others whose personal atmosphere is disagreeable. This invisible something which people carry about with them, we might call personal magnetism, or electricity. It matters little what we call it; we know that it exists. [32] The baby

feels this influence very keenly, and refuses to be quiet with some people, while with others, equally strange, it seems contented and happy. If held too long, even by one whom it likes, [33] the child's own electrical conditions become disturbed, and it cries. If taken by some one else, or put down where it can recover its own electrical state, it will become quiet. [34] This explains why a stranger can, sometimes, quiet a child, which all the mother's care has failed to still.

[35] The next demand of the child is food, which nature has provided in the most perfect form. [36] Regular habits of feeding secure health, and also establish regular habits of sleeping. The sleep of a child is sacred. You, who now know so well what is going on in the house when the windows are closed and the master is asleep, who can imagine the [37] busy servants going swiftly about the house building up, or repairing the wear and tear of life, [38] will never disturb the sleep of a child by needless noise, or jolting, or rocking; but, [39] putting it away in a quiet, darkened, well ventilated room, will leave it to the gentle care of

"Tired nature's sweet restorer, balmy sleep."

[40] But now we begin to catch a glimpse of the inhabitant of the house. We see him peep from the windows. [41] He is beginning to get acquainted with the world and with himself. His little fists play about his face with no intent or purpose, but always with the result of training some of his many servants. [42] As yet he has no consciousness that he is getting acquainted with himself, [43] even his voluntary movements are made

as unconsciously as the working of his lungs, or the beating of his heart. He does not know that he ought to exercise in order to grow, and yet he keeps always in motion.

Why is it? [44] The burning of coal produces heat; certain chemical changes produce the invisible agent known as electricity; and we can believe that changing food into tissues of the body may produce another intangible agent, the source of this constant activity which exists in the young of all animals.

They do not reason about it, but they obey the inborn impulse to exercise, because without it they will not grow. [45] As the baby's chief business is to grow, we must give him a little [46] "wholesome neglect," and a little judicious education.

[47] First, he must learn to sit alone, and all we can do is to put him on the floor, prop him up with pillows and leave him to his instincts. After a time we find the pillows can be dispensed with.

[48] After many tumbles baby learns to turn himself over, face downward, and essays to crawl like a snake. What is there in this little wriggling, squirming, crawling thing to foreshadow the grand, kingly man, standing erect, and feeling himself akin to the immortal? [49] The upward tending instinct is there, however, and manifests itself by impelling [50] the child to rise on all fours; [51] after months of such lowly progress, he stands on his feet and exults in his success; and well he may, for, to accomplish it, he has trained many helpful muscles in their functions. And now papa hears the delightful news that "baby has taken a step alone, you must see him."

The step is taken, and awakens as much applause as the most amazing feat of the acrobat, and deserves it even more.

[52] Walking is really a dangerous performance, and only becomes safe by practice. Dr. Holmes calls walking, [53] "perpetual falling with perpetual recovery." [54] Running is still more difficult: the falling being more rapid, the recovery must also be more rapid, and there is a point of time when both feet are off the ground at the same instant. Remembering the number of servants that must be trained, and that they must work harmoniously, we shall better appreciate the greatness of the accomplishment of the feats of walking and running.

We often say that a child is getting old enough to go to school and learn something, but in truth [55] a person never learns in any later five years of life as much as he does in the first five. [56] Every external object is his teacher. [57] The gay and noisy rattle, which he jingles aimlessly, is teaching his eye, and ear, and hand; [58] the doll develops his powers of imitation; the baby-jumper prepares the way for walking; the rocking-horse teaches balancing himself in a sitting position while in motion; [59] the swing adds to this the continuing of motion by constantly changing the centre of gravity, and incidentally develops courage. The skipping-rope teaches, not only, activity, but time, decision, regularity, promptness; rolling the hoop educates eye, and hand, and judgment, in measuring the strength of the stroke; [60] playing marbles teaches weight, and the application of force with a definite

object in view; ball-playing does this still better and gives more activity to the muscles. [61] Repeating a task makes it easier to perform, and at length the movements necessary to it may become mechanical, or as we say, automatic. After a few months of practice, the child has no longer to think of his feet in walking; they move automatically, and it is the same with his games. They have educated his muscles, until they have learned to do their work without the conscious supervision of the master of the house.

[62]The child is becoming master of his servants. But the education of the muscles is continued. The ball-playing becomes more scientific, his jumping has a more definite aim.

To these teachers may be added, [63] calisthenics, which add the delight of music, and education in rhythmical movements. Here the feet are first taught to move in regular sequence, under the direction of the judgment. In this we have much of the æsthetic, the poetry of motion and attitude, the charm of swift-changing muscular positions, and the picturesqueness of kaleidoscope groupings.

CHAPTER II.

GIRLHOOD.

WITHOUT doubt the title, "The Man Wonderful," [1] includes also "The Woman Wonderful," and as the "boy is father of the man," the girl must necessarily be the [2] "mother of the woman." Whatever the woman is to become, must, to a great extent, be determined by the training of her girlhood. [3] Her House contains the same rooms, and as many servants who must be trained if they are to be made of use. The same laws govern her body as govern his. [4] It is built in the same way, needing food, and sleep, and air, and exercise, in order to "live, thrive, and grow." She has the same need of a strong, healthy body as he has, and can obtain it, only by the same means. [5] The girl who has not a strong, well-developed body and skilfully trained muscles, has not been well educated. [6] Girls learn to walk, to talk, to run and romp, just as boys do, and can learn in no other way. But after a time a new influence is brought to bear upon them, with the effect of curtailing their liberty and substituting indoor quiet for outdoor exercise. "It is not ladylike," is the motto of life, [7] and girls begin to pride themselves upon their delicate complexions and slender white hands, [8] while boys, caring nothing

for these things, continue to take a pride in what they can do, not in how they look. Which is the nobler pride? A girl can be strong and full of vigor without necessarily being coarse or rough. Freedom from nature's brown color does not signify refinement or culture. Delicacy does not necessarily mean weakness. The most beautiful [9] hands are those which can do something; not merely delicate fancywork, but real, needed, every-day skilled labor.

> "Life is real,
> Life is earnest,"

[10] and the greater part of it is not to be spent in books. Therefore, girls should be taught those things which will enable them to

> "Be up and doing,
> With a heart for any fate,
> Still achieving, still pursuing,
> Learn to labor" and be great.

The education of the hands is often postponed too long. [11] Very little people can be taught to do little tasks, and take great pleasure in doing them. [12] Mothers often puzzle over the question of how to amuse their children, when the most successful way to accomplish that object would be to give the child something to do. Is a child ever so happy as when it imagines it is "helping mamma"? With tiny broom and duster the girl follows from room to room, whisking the broom and flourishing the duster, chattering blithely all the while. [13] A little careful training car

make the tiny hands capable of doing the work well, and the useful education of the servants is begun. Playing [14] "keep house" is not so attractive as the real dish-washing; and making mud pies never such "fun" as baking real bread or cake. It may try mamma's patience at first, but her reward is sure, when the clumsy little fingers become helpful and skilful. [15] A girl of eight can be a good sweeper, and duster of furniture, can set table and wash dishes; know how to knit, to sew a plain seam, or fasten on a button; can run errands, make purchases, knowing whether she receives the right change; can wipe up an oil-cloth or "straighten a room" without interfering with school duties or hours of play. A little later she can be taught some of the mysteries of cooking and baking.

[16] A girl of fourteen should be able to darn her own stockings, put a patch neatly into a worn garment, and begin to learn the art of cutting out garments. I have known girls of less years who could do beautiful work upon a sewing-machine, who had not impaired health by constant indoor labors, but who loved to romp as well as girls who had not such accomplishments. [17] The minutes that are often spent in idle personal decoration would be sufficient for a girl to gain this practical knowledge. And who can measure the advantage it may be to her in later life? [18] The daughters of the Queen of England have found this kind of manual skill most valuable.

Our public schools should be arranged with a view to teaching girls those things, which, as housekeepers,

they will be called upon to do, or to superintend, all through life. An hour a day, three or more days in a week, would suffice to instruct them in mending, knitting, repairing, or making new garments. Cutting scientifically, and fitting properly, would be easily learned where they were gathered in classes under a competent teacher; and if that teacher were instructed in the anatomy and physiology of the human body, the art of dressmaking would assume a more scientific character, and natural, healthful figures would be the aim of girls, instead of the deformities propagated by the dressmaker—deformities which called forth the criticism of the Chinese woman, who said: "Christian woman say wicked to squeeze feet. Chinese woman squeeze feet. Very wrong, but Christian woman squeeze life. Chinese woman no squeeze life. Life here"—indicating the delicate waist of a fashion-plate figure—"Christian woman squeeze God's life."

Girls are as ambitious to be helpful as are boys. They only need a chance to prove their ability. Many girls who are thought dull in books would, in an industrial department of school, develop talents of which their teachers would be proud. It would not be difficult to fit up a room where cooking could be practically taught. It is strange that we practical Americans have neglected this so long. What use is there in knowing the science of chemistry if we do not utilize it? The cooks of a nation have an influence on its health, its manners, and its morals. A knowledge of the true art of cookery would help to

solve the great problem of intemperance. It is foolish to send to England for iron when our hills are full of iron and coal; it is foolish to raise the cotton crop of the world and send it to France and England to be manufactured; and it is equally foolish to possess the most abundant and varied food supply of the world and be obliged to send to France for skilled cooks.

In such an industrial department of public schools, sewing-machines, and writing-machines, should be a part of school furniture. [19]A girl who understands the use of a sewing-machine, who can cut dresses by rule, who can measure and cut for a grown person or a child, has a feeling of self-dependence that is worth more than a moneyed inheritance; and one who can manipulate a writing-machine has a business education that secures her against lack of employment.

Girls have [20] ingenuity which should be cultivated. They can learn to use tools and construct many things for themselves that, perhaps, otherwise they could not have. A girl's hand has just as many muscles as a boy's, and they are just as capable of being trained as his. [21] It may not be well to train them just alike in all respects, but what harm can come from a boy's learning to use a needle, or a girl's learning to drive a nail? Both may find the knowledge of great value to them at some time.

[22] A boy should not be laughed at because he trains himself in work that is done in the household, nor should a girl be ridiculed because she likes the more active sports and work of life. Girls have naturally

as great a love for motion as boys, and need it as much for their development. Unfortunately, the burden of sex is laid upon them unduly. A girl ought never to be called a "Tom-boy" because she runs and climbs; or a boy sneered at because he washes dishes. [23] The girl obeys a God-given impulse of activity; the boy, probably, does violence to his own wishes in order to lighten the burden of mother or sister; and both are worthy of commendation.

The words [24] of blame, "It is not lady-like," or "It is not genteel," should be changed to "It is not right," "It is not noble," and then we should be better able to understand whether the active instincts of the girl are to be blamed.

As girls [25] approach the years when they leave school they should begin to think of the actualities of life. At that age a boy decides upon a trade or a profession. He expects to take care of himself. The same ambition is equally praiseworthy in a girl. [26] There is no more reason why girls should plan to be dependent than that boys should make the same plan. [27] A trade is a fortune to a girl, as well as to a boy, and every girl should be able to do something so well that she can earn her own bread, and that, too, although she can see no possibility of the need of such skill; the need may arise. What that work may be, her own inclination or talent can decide.

A wide [28] variety of employments are open to women, from dressmaking to doctoring, from teaching to preaching. Women can be architects and plan dwellings to suit the need of the housekeeper better

than men. They can decorate and furnish houses as a business; they can learn telegraphy, stenography, nursing, farming, raising of small fruits, gardening, raising of bees, poultry, or silk culture. They can practice law, make bonnets or books, but in whatever line they labor the skilled hand is desirable. Even in the professions a knowledge of manual labor is advantageous. That novelist can best touch the heart of the people, who knows in reality what are the trials and labor of the people. The minister can minister more skilfully if he can meet the working folks on their own level.

A knowledge of [29] practical work broadens the thoughts, increases the sympathies, gives a wider horizon, and adds to the value of the individual. [30] A girl who can play on the piano and cook beefsteak properly, is more of a woman than one who can do only one of these two things. A girl, as well as a boy, should desire to be a ruler of the material forces of the world, and not to be ruled by them. [31] She should be ambitious to be a producer, and not merely a consumer. She should exist to make herself felt, not merely to be looked at; to be praised for the work which she does, instead of being wondered at for the work that is done for her.

To be useful is more womanly than to be idle. To have practical accomplishments is to be endowed with gifts which shall unlock many gates of happiness. [32] Read Solomon's picture of a virtuous woman, in the last chapter of Proverbs, and see what a price he set upon skilled labor.

CHAPTER III.

BOYHOOD.

[1] THERE is an inborn pleasure in accomplishing something, manifested in the child by its playing at work, and, later, by its attempting to do actual work. The wagon made of a match-box, mounted on wheels of spools, gives more real satisfaction than the most expensive boughten express-wagon, however gayly painted. [2] This desire to do, should be carefully cultivated by parent, guardian, and teacher.

The world of books is very charming, and the world of work no less so. [3] The lives of the majority of people must be spent in doing rather than in studying. Theory is good, but practice is better; [4] and a valuable addition to all our schools would be an industrial department, where pupils could spend a part of each day in the practical application of the theories taught in their books. [5] Such schools have been found of immense value in Germany, and would surely be no less so in a country which boasts of being a land of doers, as does America.

[6] Hours of work alternating with hours of study, give a more symmetrical development of mind and body, and the [7] boy does not need to leave school so young in order to learn his trade. [8] He learns the use of tools, and working in wood and metals. At

the same time that he is studying the science of Natural Philosophy and the laws which govern wood and metals, [9] he is becoming a skilled workman, and not the follower of a routine. With such a school system, [10] there would be less need for compulsory laws of education. Parents, knowing that their children were learning trades while still [11] in school, would see no reason for shortening their school-days, but, on the contrary, would find every reason for lengthening them.

These industrial departments can unite the important teachings for both boys and girls and need not confine either sex to one department alone. [12] Girls can learn to use tools; under the modest, timid grace of the maiden may hide the skill of the sculptor; and the [13] boy may have a talent which may make him a cook able to command a salary equal to that received by a member of Congress.

[14] True education is a leading forth of the natural talents of the individual, not the cramming with foreign material. To educate, then, is to [15] develop both mind and body. [16] The ancient Greeks, who believed man to have but the one nature, cultivated the physical as a means of gaining mental and moral power.

[17] To cultivate the mind and neglect the body, is to dull the tools which the mind must use. [18] To cultivate the body and neglect the mind, is to increase the strength and power of the tool, and weaken the force which should guide and direct it.

[19] In our colleges are young men who are possessed with an idea of championship; they are not

striving to develop a symmetrical body, beautifully poised and perfectly balanced, in the hope that it will be a [20] support to their higher powers of mind, a foundation for the most useful mental and spiritual manhood; [21] but they are thinking how they can acquire that development of arms and legs which shall render their picked "nine" the superior of any other college "nine."

It is true, no doubt, that often the effort to rebound from the inertness of the student leads to the other extreme, of over-cultivation of the body. [22] The golden mean would be better found if mental and physical education were carried on together. [23] The separation has evil results, making, on the one hand, the mere student a weak, nervous dyspeptic; and on the other, the gymnast a mere supple animal, and developing a low standard of manhood.

[24] For purposes even of war or dominion, there is no longer need of extreme development of physical strength. [25] Through false methods of development there is positive injury to the body.

In the rowing contest, for example, the strength is so long and powerfully exerted that exhaustion follows. The arms, back, and legs are not the muscles that suffer serious injury, for they can rest after the contest; but there is a muscle which has been called upon to do the largest and hardest share of the work, and has had no chance to rest. [26] It is the Engine, the heart, which has forced the life-giving fluid through the whole system during the strenuous efforts of the whole muscular system. [27] It has been compelled to

contract more rapidly, and also with increased force in order to overcome the great tension of the actively-working muscles.

[28] Under such a drill, the arms would increase in size, or, as we say, become hypertrophied; and the same is true of the heart. [29] For a time it grows larger and stronger; but there comes a limit to its growth and to the power of tension in its fibres, and when this point has been reached [30] there begins a degeneration of its fibres. It loses its tonicity, and becomes [31] a weak heart, and the person owning it has lost a great portion of his physical manhood, and, what is far more serious, can never wholly regain it. He may succeed in ordinary efforts; but, as to all great physical exertion, he is an invalid. [32] He may not be conscious of it, and may start upon a contest with all his former buoyancy, but before the struggle is ended he finds his best efforts are fruitless of result. The loss of heart-power may be progressive, and in a few years his friends are surprised to find him [33] suffering with some chronic disorder, and liable to lung trouble. A slight inflammation of the lungs may prove fatal, simply because his heart can not perform its duty, and he dies a martyr to injudicious physical training.

[34] Military drill is a method of physical development which can be made beneficial to students, professors, and to the State, and which can, scarcely, be made responsible for the same injurious results. [35] Nearly all of the muscles are brought into play, and an erect and noble bearing is taught. [36] The disci-

pline of prompt obedience is a valuable mental drill, and the [37] mischievous results which spring from emulation are not felt. [38] In actual life occasions may arise where in panic, excitement, or the collecting of mobs, there will be need of men who can command men as soldiers, and need of men who, as soldiers, can obey. Such occasions will continue to arise, and well will it be for the security of the country [39] when her young men know how to perform the duties of soldiers in order that there may be neither mobs nor wars.

CHAPTER IV.

MANHOOD.

MAN, at first, like other animals, knew no other use for his mouth than to make it a receptacle for food, and an outlet for cries of need and pain. Doubtless, man had in the beginning the same perfect vocal organs as now, but was ignorant of their use. Ideas and thoughts he had not, but as time passed on and his mental powers developed, and he began to think, he did not know how to express his thoughts. He would first express them by grunts, signs, and gestures, as do the Indians, when they meet those whose language they can not speak. After a time, these grunts would begin to differ from each other, and eventually a certain sound would have a permanent meaning. These sounds, at first made wholly in the throat, would gradually be modified by the action of other organs, until at last the tongue and lips would unite with the larynx in making many combinations of vocal sounds. In this way, slowly and laboriously, a language could be invented which would be increased by each new experience.

The mocking-bird imitates every sound it hears, and the monkey tries to do whatever he sees done.

The human animal combines both of these inclinations by repeating the sound he hears and performing the actions he sees, so that his young easily learn to talk and to do most things done by the parent.

So much has been accomplished by the Man Wonderful in all directions, that a lifetime is now too short for one person to learn all that man is able to do, or to understand all that the vocal organs are capable to pronounce. There must be a selection, and this should be of those things which are most worthy of being learned.

Since there are many languages, and all can not be learned, let the youth be taught those which will be of the most practical benefit. His native language in perfection should be his chief study; to speak it correctly and fluently, to read it with expression, and to write it with ease. To speak and read, so as to give the most pleasure to hearers, a proper use of the vocal organs is needful. Among Americans there is a tendency, both in conversation and in public speaking, to pitch the voice too high, destroying its musical qualities and rasping the ears of hearers. Orators fancy that to be heard they must scream and strain their throats, when, in fact, a lower tone, if the words are distinctly articulated, will be more easily understood, even by those at a distance. It is a mistake to scream in the ears of deaf persons. It is distinctness of articulation that is needed, not a high pitch. The voice is really weakened instead of being made more powerful by pitching it high. These vocal organs which the Great Architect has given us should be used

to bring to us the most good and to give the greatest pleasure to others. What wonders they can perform, trilling like a bird, bringing tears by the pathos of their tones, speaking in thunder or tenderly beseeching. And how marvellous is the Man Wonderful in all his attributes. Strength, majesty, power, dominion, are his, and yet, how feeble is his greatest achievement compared with that of his Maker. What strange contrasts are there in his make.

"How poor, how rich, how abject, how august,
How complicate, how wonderful is man!
How passing wonder He who made him such.
Who centred in his make such strange extremes
From different natures marvellously mixed;
Connection exquisite of distant worlds,
Distinguished link in being's endless chain,
Midway from nothing to a deity—
A being ethereal, sullied and absorpt;
Though sullied and dishonored, still divine,
Dim miniature of greatness absolute,
An heir of glory, a frail child of dust,
Helpless immortal, insect infinite,
A worm, a God, I tremble at myself,
And in myself am lost. At home a stranger,
Thought wanders up and down, surprised, aghast,
And wondering at her own. How reason reels.
Oh, what a miracle to man is man."

AS HUNTER.

How do you suppose that sheep and cows know that grass is food? If you were to ask a man of science he would tell you that it is by instinct. And then you would probably ask, what is instinct? One

of the hardest things in the world is to give a defini tion of a word, even though we may understand it. Instinct is the knowledge animals have that does not come to them by any process of thought or reason. They do not stop and think, "Now this is what I want to do, and such will be the best way to do it." But at once, without thought, they do it and in the very best way. They are guided by a divine impulse implanted in their very nature. It is by instinct that the bird builds its nest. By instinct it flies south when winter approaches. By instinct the young of all animals seek their first food, and by instinct they are directed to a change of diet when they are older. The members of one family have always the same instincts. Sheep eat grass and wolves eat sheep, and never is the case reversed. Sheep never dine on wolves, or wolves on grass.

Man possesses in less degree this faculty of instinct, but he has other endowments which make up for this deficiency. In his savage state man lives among wild beasts, and is as wild and ferocious as they. Like them he hunts his food as prey. But as he can not overpower all of them by superior strength, he must needs bring his reason to his aid, and this teaches him to use stratagem.

He takes lessons of his brute companions, but he improves on their methods. The members of the cat family steal upon their prey. Man, too, creeps upon his game, but meanwhile he studies them, and learns their habits and uses this knowledge to help him to success. He sees the trap of the spider or of the

ant-lion, and he, too, invents traps, not of one but of many kinds.

He lures the wild duck by decoys in the shape of wooden ducks placed inside his trap. He deceives the quail by the clear whistle of the "Bob White." He makes pitfalls for the unwieldy bear, and with lassoes catches the swift, wild horse.

Animals hunt because they are hungry. Man hunts not only because of hunger, but because he takes pride in overcoming, by his skill, the strength and wariness of animals. He feels a pride in his success which animals do not feel.

He wears the feathers of eagles as a headdress, and the claws of wild beasts as jewels. And his greatest pride is to display the skin of a leopard or tiger that he has himself killed.

When the animal has satisfied hunger it slays no more; but man continues to kill, that he may boast of his murderous deeds.

He cultivates his endurance, educates his eyes and ears, and increases his ability to take life by inventing weapons of death. He learns the panther's cunning, and adds to it the sharp edge of the tomahawk. He disciplines himself in running, and then adds to his fleetness the swiftness of the arrow and the whizzing lasso.

He studies the habits and peculiarities of animals, and uses his knowledge to bring them within his reach. He can not run as fast as the antelope, but knowing the animal's curiosity, he ties a bit of cloth to a stick, and hiding himself where the wind will

blow his scent away from the antelope, waits for him to come to examine his bait, and shoots him.

Not only does man invent weapons to help him hunt, but he employs the natural hunting qualifications of other animals to aid him. The hound with his keen scent can track the deer, the greyhound with his fleet foot can overtake, and seizing him at his vulnerable point, hamstrings him, and thus renders him an easy prey to the hunter. The yellow hound tracks the game by scent alone, the greyhound by sight alone, and when he can not longer see the game, is worthless for pursuing. But the hunter with his keen, educated eye, and his close powers of observation, unaided by scent, will observe every broken twig and every overturned leaf; note every circumstance which will determine the course of the deer, and of the three, will be most sure to track the game, and to secure it when brought to bay.

Man has not the speed of the deer, but has greater endurance, especially when aided by his wisdom. The hunter chases the deer, and while refraining from more than sipping water at the streams, allows the poor, hunted animal to drink his fill, and he thus is made less active and enduring by the excess of fluid taken. The hunter, fresh as at the start, keeps on hour after hour, until the animal sinks with fatigue and falls a certain prey.

He devises traps for catching the feathery tribe, and educates the falcon to aid him in the chase. He does not stop here, but enters the watery element, and contests his cunning with the fish, and captures even the shark and the mammoth, mammal whale.

Thus we see that of all animals man is the greatest hunter. He is, of all, the most courageous, needing not the stimulus of hunger to make him face danger or death. He is the most cunning, his intellect making use even of the instincts of animals to bring them into his power. His educated eye is of more use than the keen scent of the foxhound or the swift foot of the greyhound. His educated reason renders him superior to the fleet antelope and deer, and his inventions make him able to combat successfully with the fierce inhabitants of wood, or sea, or jungle.

AS TAMER.

When you have been playing with your dog or your cat did you ever think that they once were wild animals? Of course I do not mean that especial cat or dog, but that ages ago all of the canine, or feline, families were wild. How, then, did these particular members become so tame and gentle? Let me ask you another question, What makes the ox and horse willing to work for you and obey you? Were they ever wild? Yes, all of our domestic animals were once wild and shunned the face of man. But man by superior wisdom has made them, not only his companions, but his friends and assistants. By associating with man many of their characteristics have changed. They are no longer so fleet, so ferocious, so unworthy of trust, but have become mild, gentle, trusty, and useful. Did you ever read that description of a horse in the book of Job?

> "Hast thou given the horse strength?
> Hast thou clothed his neck with thunder?
> Canst thou make him afraid as a grasshopper?
> The glory of his nostrils is terrible,
> He paweth in the valley and rejoiceth in his strength;
> He goeth on to meet the armed men."

Yet this fierce, strong, mighty creature has become the willing and affectionate servant of man. He is harnessed and made to bear his burdens; to prepare the ground for crops; to bear upon his back the joyous rider; or to drag after him safely a group of laughing children. He is tamed, subjugated.

The cat, who is a cousin of the tiger and the panther and the lion, is our household pet. The dog, cousin to the wolf, shares our sports as well as our pleasures. The ox and the sheep are so tame that we find it difficult to believe that they were ever wild. They furnish us food and clothing. They toil for us, and are cared for by us. The elephant, who in his wild state is so fierce and dangerous, becomes obedient to man, and not only works for him but tenderly watches over his keeper's little child, obeying the infant's voice as if ignorant of the weakness of the child and his own monstrous strength. The camel is made the burden-bearer of the merchant over desert wastes, and in Arctic snows the reindeer is harnessed to the sledge of the native. Boys begin very early to tame animals, and their numerous pets show their skill. Not only are cats, dogs, or chickens made pets, but squirrels, raccoons, mice, and the young of fiercer animals are subdued by the juvenile man,

But men are not content merely to tame those whom he can make use of in his work, but he loves to show his superiority by subduing the wildest and most ferocious. You have seen men sitting in cages of wild animals, tigers, leopards, or lions, and have seen how they were not afraid, but had really terrified even the king of beasts. The venomous serpent is made to obey the commands of his ancient enemy, man, and has even been taught to dance in time to music. Is man the only one among all created beings who enslaves or makes use of his fellow-creatures? O, no! The cuckoo lays her egg in the nest of other birds, and thus makes them feed her young, often to the neglect of their own. She does this, it may be, because she is cowardly or lazy, but she does it. She makes the other bird serve her purpose. The great red ants, called Amazons, make slaves of the young females of the black ants, and make them act as nurses. Man is not the only captor. But he captures the greatest number, and not only tames those whom he can use, but he gratifies his pride by overcoming those whom he can never trust to work for him, as is the case with the lion and tiger. Those whom he has trained to be his faithful servants in different parts of the world are the horse, the ox, the ass, the elephant, camel, dog, goat, reindeer, buffalo, zebra, sheep, and if you wish to make up a round dozen you might add woman to the list, for I have seen, in Belgium, a woman and a cow hitched together plowing in the field, and I have also seen women and dogs, in Prussia, working together to pull

a wagon. But if this adds to the number of man's captives I do not think it adds either to his courage or his credit, and yet it speaks well for the human race, for it shows a willingness on the part of the mother to toil and to endure and to suffer, if need be, for the support of her young. It is a noble characteristic of the human family that they will work and labor for each other's good. The suffering of the few calls forth the sympathy and assistance of the many.

AS FARMER.

Did you ever try to satisfy yourself by reflection how man became a farmer? If he lived upon the fruits and seeds of plants in the summer, and upon the flesh of wild animals in winter, he might have got along for a time; but when his numbers increased to such an extent that food failed, he must do something.

Did he then invent the bow and arrow before he did the rude hoe which he used for digging up roots? It is certain that at some time he invented tools for tilling the soil, and for clearing away the forests. When he learned that he could direct the force of other animals, he made harnesses for them, and invented plows and harrows. As we look back we can see that his progress was extremely slow. In some countries more so than in others. But in all countries there has been a continual progress. Even the stone age was far in advance of the age when there had been no invention. By experience man

learned which plants produced the most food with the least labor.

A few years ago I saw at Vienna, Austria, a collection of plows, some of them 200 years old, and I was astonished to see how little progress there had been in that length of time. In Italy I saw a plow in use which was made from the fork of a tree, and which was drawn by three yoke of large white oxen. It did not turn a furrow, but it stirred the soil.

Man learned to improve the quality as well as the quantity of his products. The knowledge of plant-life, gained by experience, has been a great aid; and in the last fifty years science, which has been slow in its growth, has come to his assistance. Skilled hands have manufactured light hoes, forks, axes, and scythes.

The grain-cradle was one of the most important inventions ever given to the farmer, but its importance is now hardly appreciated because of the more skilful inventions that followed it.

The mowing-machine was the most wonderful advance in farming, and stimulated thought for farming-machinery in every direction. The farmer of to-day plants his grain, not from his hand, as he did only a few years ago, but from the drill. The horse helps in every kind of labor. He plants and sows; he reaps and mows; he rakes the hay, and pitches it into the mow or upon the stack. He not only cuts the grain and puts it into gavels, but he binds it and threshes it, and if necessary grinds it. He plows and cultivates the corn while his driver rides, if he pleases, protected by his umbrella from the rays of the sun.

It would appear almost as if man's many efforts to make the horse useful had been the cause of his own advancement as a farmer. The horse makes his roads, digs his ditches, pulls his stumps, saws his wood, and assists him to fell the trees of the forest.

But the horse has not always been sufficiently powerful to satisfy his ambition, nor yet has the camel or the elephant, and so the steam-engine has been harnessed to the plow, and the cultivator, and the harrow, and ten or twelve plows now turn their furrows across the field at the same time.

How can any one go upon a well-equipped farm and see the practical corn-planter and sulky-plow, the strong mower and the ingenious reaper and binder, working in all their perfection, without great admiration for the Man Wonderful.

AS WORKER.

"The groves were God's first temple," and they were also man's first workshop. His first tool probably was a stick, with which he knocked down fruit that grew out of his reach, or dug up some root that he desired to eat. Out of wood he formed his first rude bow and arrow, and wood has been an important constituent of his improved weapons of warfare, as well as of his implements of peaceful toil. The cunning and skill of his hands have made the woodwork of the modern plow a vast improvement over the simple forked stick with which the primitive farmer tilled the soil. Man soon perceived the adaptability of wood to building purposes. Begin-

ning with the rough poles which formed the framework of his wigwam he has progressed through the log-cabin and board "shanty" to the most elegant modern dwellings made and ornamented with wood.

With his axe the sturdy backwoodsman has hewn through the heart of pathless woods a road to honor for himself and glory for his country.

With the historic hatchet from the historic cherry-tree he has carved an everlasting figure of Truth, and with the pine stick and jack-knife has whittled out the renowned wooden hams and nutmegs as well as whittling himself into the statue of the representative American.

From such simple labor he has progressed until wood, under the carver's hands, has become not only a work of art, attesting the genius of man, but a contributor to our comfort and well-being in myriads of forms, and each particular article marks the progress of man's skill in wood-working. The board, upon which the Indian pappoose is strapped, the log cradle of the pioneer's baby, and the elaborately carved *bassinet* of the infant emperor are proofs of his skill.

From the first rude musical pipes made from the reeds that grew by the river's bank, man has advanced until a myriad of wooden musical instruments sound forth his praise. A wonderful instance of skill in wood-working is found in a Brooklyn violin-maker, who has been able to make a violin that as soon as completed has the appearance and tone of an ancient Stradivarius or Amati centuries old. We are proud of such men who give us a national pre-eminence

and we rejoice in the simplest efforts of our boys and girls, because they are the prophecies of better things.

The rude cross by the roadside, and the exquisitely carved pulpit or shrine, are not merely symbols to be regarded with reverence, but are incontrovertible facts which attest the continued growth of a divine gift to man.

AS USER OF METALS.

The old mythology tells us how fire was stolen from the gods. I have often tried to satisfy myself that man obtained it through some skill of his own, but have failed. Like many of the most important discoveries, its origin was doubtless accidental.

Equally mysterious is it how man learned that metals were in the earth, and could be made of avail. It would be of intense interest indeed to know who made the discovery, and how. He must have been a thoughtful man; but no matter how keen his natural powers, he could not have had the faintest idea of the value of his discovery. His first use of metals was doubtless in producing weapons of warfare, and the skill of ancient peoples in this respect, at least in some directions, has not been surpassed by modern inventions, as is witnessed by the keen Damascus blade which could be tied in a knot without breaking. But our modern Vulcans surpass the men of every age in the manufacturing of metals into implements of peaceful industry. The useful arts made but slow progress in the many centuries preceding the advent of gunpow-

der and the making of cannon. It is true that many beautiful ornaments had been made, and gems had been surrounded with metals more or less precious; the walls of the Coliseum had been bound in places by iron bands, which, later, formed a mine of wealth to the Italians. An ignorant and arrogant commander had attempted to put an unruly river in chains, but it was not until after the hoarse sounds from the throat of the cannon, the great destroyer of human life, that men awoke to an appreciation of the strength and importance of iron. The search for liberty and the struggle for an opportunity to develop true manhood, established a new nation upon a new continent, and in the new land new thoughts awakened a new series of ideas. The steel age in which we live is the age of earth's greatest advancement and prosperity. The manufacturing of firearms from iron, only opened the way to the making of steam-engines, railroads, and bridges of steel. Nearly everywhere iron and steel are united with wood, as in our tools, vehicles, and ships, but in many places steel is used alone. The "swamp angel," which threw solid shot seven miles into Charleston, and the twenty-inch cannon at Fortress Monroe, fall into utter insignificance before the skill of a Krupp, who has made a steel gun that throws a 300-pound solid shot, or shell, fifteen miles.

Steam might have been looked upon as a demon had not man confined him within bounds, harnessed him with steel, and compelled him to serve. He has made for him steel road-beds upon which he must travel across continents, dragging after him a swelling

train of industry and wealth. He has compelled him to descend into the depths of the earth and bring up treasures of salt, iron, coal, silver, gold, and precious gems. He has penetrated those vast reservoirs of oil which, from creation's birth, lay hid beneath primeval rocks, bringing from the very abodes of darkness a light to illuminate and cheer the world. Steam harnessed in steel has plowed the mighty deep, and transporting summer to the doors of winter's fortress, has returned with winter's ice to cool the glow of tropic climes.

By machines of his own construction man has brought from hidden fountains, embowelled deep in rocky beds, pure and delicious water to supply a city's needs, or render productive desert wastes. Bridges span the torrents, men travel on aerial roads of iron, or stretch an iron thread around the globe to bear their words to earth's remotest bounds. With greater truth than Socrates, may the man of this steel age exclaim, "I am thinking myself to be a citizen of the whole world."

So man has found his greatest wealth among the metals to arise, not from the shining gold that, like an evil eye, lures him from home and comfort; nor yet in the glittering silver which gleams from the darkness of mine or cavern; but in the dark, dull lead, copper, and iron which he fuses, molds, or forges into shapes of usefulness and enduring strength.

Since Peter the Great worked his way through the rough paths of a mechanic's life, and learned how to build ships and implements of warfare, in order that

he might teach his people how to work and protect themselves, it has become fashionable, and almost necessary, for the scions of royalty to learn how to do some kind of work. Shall the sons of free America be less ambitious, and have a less worthy and solid foundation upon which to build?

The fame of Washington towers above that of any other statesman or ruler, and a grateful nation has erected a monument to his glory that looks down upon all other monuments made by men. Happy the people who have produced in their midst noble, wise, unselfish patriots, worthy of such monuments. The world has had but one Washington, and he an American.

Some men are able to build and carve their own monuments, and even while living can rejoice in enduring works of their own hands which are emblems of their courage and constructive skill. The massive steel bridge across the Mississippi, at St. Louis, is a lasting monument to the ability of Captain Eads, and the deepened mouth of the Mississippi declares his greatness.

The magnificent Brooklyn Bridge should be known as the Roebling Bridge, for no greater monument to the honor of father and son exists, nor should the wife of the son be forgotten, for without her care, intelligent assistance, and womanly devotion it might have remained incomplete. A courageous young lieutenant, a scientific investigator, has carried the American flag into the home of the North Wind, and by so doing, defied old Frost King in the heart of his

own empire. The lieutenant with his twenty-four comrades built a house in a province of the empire, and laughed at the threats of the Frost King. During two years they surveyed his dominions and mapped out his unknown posessions and caused a record to be made of his boundaries; they estimated the strength of his fortresses and defied the dangers of his crystal mountains. With their scientific instruments, they measured the blusterings of the North Wind, and recorded his intemperate changelessness and the destructiveness of his perseverance. They brought away, as trophies of their courage and scientific skill, the records of their researches.

The Frost King fortified the passages of their retreat and prevented their meeting with comrades. Courageously they endured privations and looked homeward for assistance and succor, while fifty millions of their countrymen were anxiously wishing to aid them. Six of the twenty-five immortals have been rescued none too soon for the glory of America. Their countrymen are proud of their success and all nations are interested in these achievements, and with admiration speak of Lieut. Greely. Let our youths be encouraged to exertion in every worthy field, for the monuments are numerous that may yet be erected to declare the glory of successful labor and ennobled manhood.

CHAPTER V.

DOUBTFUL COMPANY.

DID you ever feel that there was something that you ought to say, and yet you wished you did not have to say it? That is just the way I feel now. There are two foreigners who are such honored and welcome guests, in nearly every household, that I would be glad to speak only good of them, or, not being able to do that, to keep silence about them altogether. But that I can not do. So I will tell you what science says in regard to them.

[1] Once upon a time, about two hundred years ago, one of them, whose name is *Coffea Arabica*, was brought to France and England for the first time. Till then people had never made his acquaintance in those countries. Since then he has travelled extensively, and nations widely separated have made his acquaintance, and have become much attached to him. [2] He is familiarly known as Coffee. I need not describe him to you. Many of you see him every morning, may, perhaps, have even more than a bowing acquaintance with him. You like him, perhaps; and you begin to frown, and say: "You need not tell me that he is a bad fellow. I know better. He never harmed any one." Well, I will not quarrel with you. I will only tell you what his reputation is among the

learned, and leave you to say whether you will make a friend of him or not. [3] Those who argue in his favor say of him that he checks waste, and therefore is indirectly a food. [4] To check waste is to fill the system with dead matter, and that is not desirable.

[5] "Anything that checks waste disturbs vital functions," is the testimony of science. [6] Coffee contains some nutriment, but its chief action is stimulating rather than nourishing. [7] It makes a person forget that he is tired, which may be pleasant; and yet, after all, may not be desirable. [8] If we know that we are tired we will rest, and so the material which has been worn out by exercise will have a chance to be removed and replaced by new material. But if we forget that we are weary, we, perhaps, will continue to exercise and so destroy more tissue than will be rebuilt, and so we will tend to break down.

[9] Dr. Bartholow, who treats of coffee wholly from a scientific point of view, says: "If used to excess, as a beverage, coffee deranges the organs of digestion, producing acidity, flatulence, pyrosis, eructations, headache, vertigo, ringing in the ears, and wakefulness." That is not the effect of water or other true foods.

[10] Dr. Emmet, another authority, says: "I find coffee, even when weak, to exert a very deleterious influence, in consequence of its indirect influence on nutrition. [11] Whenever a patient has become addicted to the use of stimulants, anodynes, or coffee, an effort must be made at once, without a compromise, to break up the dependence upon either of these insidious poisons to the nervous system."

[12] Because coffee is so widely known and used some people think it is a necessity to man; but to quote again from Bartholow: [13] "Such a view is hardly tenable, the highest physical and mental activity not being incompatible with entire absence from it." [14] That is, men can be strong, and healthful, and intelligent, in the highest sense, without ever using coffee.

[15] That being the case why should we put ourselves under his control, for he, too, is a guest who becomes a master? [16] We can keep well, and strong, and happy without him. Why not stay on the safe side?

[17] The other foreigner, of whom I wish to speak, is a Chinaman. But I do not imagine that our people referred to him when they said: "The Chinese must go." In fact I fancy that, if they had supposed the banishment of the Chinese from our shores had meant the banishment of this dear friend of theirs, they would have thought more than twice before they had said, we will have no more of the Chinese.

[18] This guest, with whom you are all more or less acquainted, is named *Thea Chinensis*, but familiarly called Tea. [19] Sometimes his complexion is green, sometimes black, and so he is known as Black or Green Tea. [20] Tea has properties similar to those of coffee, and, as might be supposed, the effects are similar. [21] Green tea is said to be more stimulating than black. [22] The tannic acid in tea coagulates albumen. You can decide for yourselves whether that is desirable in the body. [24] Long cooking of tea extracts its acid, and therefore increases the deleterious qualities.

Bartholow enumerates the effects of tea as the same

as those of coffee, and adds: "The habitual effects and the evil results of habitual excess are best seen in sewing-women addicted to tea-tippling. [25] It is not uncommon for these women to live upon bread and tea for long periods, resulting in their becoming excessively nervous and dyspeptic. The mucus of the stomach plays the part of a ferment, the bread undergoes the acetic fermentation, and this process is facilitated by the presence of a quantity of a weak astringent solution. [26] Disorders of digestion, due to this cause, can be removed by withdrawal of the offending beverage." [31] And that means that if tea is harmful to you, don't drink it. The only persons who can drink tea and coffee, with a reasonable excuse, are those who are more than forty years of age, and many of these can not. [27] A very good rule of conduct, in all cases where there is a doubt, is to give yourself the benefit of the doubt. There is not the least doubt that you can do without either tea or coffee, and not be harmed; therefore, to give yourself the benefit of the doubt, is to stay on the safe side, and not use either. [28] Water will not stimulate you, nor harden the albumen, nor check waste. [29] Three-fourths of the body is water, while tea and coffee are not natural constituents of the body. [30] The only good they do in the system is by the water they introduce.

[32] There are other visitors to our house who might also come under the head of doubtful company. They are classed under the general term, condiments. [33] The pepper, sauces, spices, which are used to stimulate appetite, do so by irritating the mucous mem-

brane, in reality creating an excitement in the kitchen, and making the servants express a desire to get rid of these friends who bite.

[34] Pepper and mustard, put upon the unsensitive epidermis, will raise a blister, and [35] much sooner will they have that effect upon the delicate mucous membrane of the mouth, stomach, and alimentary canal.

Like many other things which are not true foods, their use begets a [36] desire for an increased and increasing quantity; and the person who began with a small amount of pepper will in a few years want his food quite black with it. [37] Any article whose use produces an intense desire for its continued and increasing use, a craving which no other article will satisfy, may safely be set down as injurious. Wholesome food never creates such a longing. We do not eat one potato to-day, and to-morrow want two, and next week three, and so on increasing the quantity, and feeling unsatisfied unless we have potatoes. And the same is true of all wholesome foods. But tea, coffee, and condiments demand increase, both in strength and quantity, and create a desire that will not be appeased by any wholesome substitute.

We have an exceedingly kind and faithful friend, whom, however, we do not love, for he never speaks to us unless he has something unpleasant to say. His name is Pain, and when he begins to scold and chide us, we think of nothing but finding some means of silencing him.

There are certain guests who are sometimes invited to the house just because they have the power of

compelling Pain to keep silent. They are false friends, for if we are not very careful, they end by enslaving us, and what is worst of all, we may come to love our chains.

One of these doubtful friends is named Chloral Hydrate. He has been an acquaintance of the Man Wonderful about twenty years. At first he was considered to be a very valuable friend, for he quieted Pain, and gave the Master delightful sleep.

But in time it was learned that he very sadly interfered with the work in the Kitchen and Dining-room, and, as a consequence, ultimately with the health and well-being of the house. The Master found, when too late, that after employing Chloral Hydrate to give him sleep, he became unable to sleep without the soothing effect of this narcotic, and finally, such large and increasing doses were required, that the health became utterly ruined, and Pain, refusing, at last, to yield to the Tyrant's dominion, made life an intolerable burden.

Another false friend who comes to silence Pain, and ends by enslaving the Master of the house, is called Opium.

He has long been known in Eastern countries, and is becoming more and more widely known in our own land. His personal appearance is not attractive, but so strong is his influence over Pain that he receives a very cordial welcome by those who suffer. Soon after he enters the house he takes Pain by the throat and throttles him, and sends a wonderfully peaceful feeling through the whole house. He par

alyzes the nerves of sensation so that they carry no messages, and the Master fancies that, because he hears of no trouble, none exists. But after a time the servants of the house are aroused from the torpor into which they are always thrown by the presence of Opium, and begin to make most agonizing complaints. Driven by this torture perhaps, Opium is again invited to produce quiet, and his presence acts like magic, and in this way he comes to have such a power, that the Master is willing to forgive him for all the ills he creates because of the power he seems to have in soothing them. This goes on until the Man becomes a perfect slave to Opium, who alternately tortures and caresses his victim, until he at last forces him to vacate his once beautiful house, now despoiled, and rendered utterly unfit for habitation. The slaves of Opium may possibly be freed from his chains, but it is very doubtful if they ever are.

The poet Coleridge, who for many years was an opium devotee, writes: "There is no hope. O God! how willingly would I place myself under Dr. Fox in his establishment; for my case is a species of madness, only that it is a derangement, an utter impotence of volition, and not of the intellectual faculties. You bid me rouse myself. Go, and bid a paralytic in both arms, to rub them briskly together, and that will cure him. 'Alas!' he would reply, 'that I can not move my arms is my complaint, and my misery.'" After a fearful struggle Coleridge was liberated from the dominion of Opium.

De Quincey, who also freed himself from this tyranny, says: "I triumphed, but think not that my sufferings were ended. Think of me as of one who even when four months have passed, still agitated, writhing, throbbing, palpitating, and shattered."

This is how Opium serves those who trust him. Far better would it be to ask *why* Pain is chiding us, and to so regulate our lives that he could find no chances to complain, than to close his mouth by Chloral Hydrate, Haschish, Absinthe, or Opium, and by so doing become their abject slaves. Of all those who come under their dominion, not one in a thousand has strength to break the chains and become free.

Some preparations of opium are injected under the skin. In this case the effect of the drug manifests itself more rapidly than if taken into the stomach, and the opium habit thus formed is as hard to break as when it is smoked, or taken as a pill.

If ever these powerful and poisonous drugs are introduced into the system, it should be under the direction of a competent and honest physician, who will never permit a patient to be the judge of when, how, or how frequently such dangerous guests should enter the House Beautiful.

Come, I offer you my hand. Shall we agree to keep away from doubtful company, as well as that which we know to be injurious in the extreme?

CHAPTER VI.

BAD COMPANY.

"A MAN is known by the company he keeps."

Men of low tastes and vile habits do not choose for companions those who have pure tastes and high aspirations. [1] You have not forgotten that our house is guarded by twin-brothers, Taste and Smell, whose duty it is to examine all those who present themselves as candidates for the acquaintance or friendship of the master of the house. [2] They are both very candid, and express their opinion very decidedly. [3] Whatever Taste dislikes is sure to be disagreeable to the other servants of the household; [4] and if the master becomes strongly attached to bad friends, the only thing the servants can do is to try and make the best of a bad matter. [5] It is then to the master of the house that we [6] must appeal, if we would prevent the formation of hurtful friendships; and it is he whom we must educate to recognize these objectionable claimants for his favor.

[7] The first one of whom I will speak is a native of America, but is widely known over the world. [8] When Columbus, in 1492, landed on the shores of this New World he was met by this distinguished American. [9] Cortez, when he conquered Mexico in 1519, also met

him. [10] He was always present among the North American Indians at their religious ceremonies, and was indispensable to the conclusions of treaties of peace as well as to declarations of war. [11] He was soon introduced to European society, and received with much kindness. [12] He was taken to Spain and to France, being presented to the Queen Catherine de Medici, and in France was called *Herbe de la Reine;* and to the Church authorities of Italy about the year 1560, where he was known as *Erba Santa Croce.*

Quite a number of gentlemen claim the honor of introducing him to the nobility of England, [13] but Sir Walter Raleigh generally obtains the credit. In 1601 he was carried to India, and in 1609 to Java. He was popularly supposed to have great powers in the curing of disease, and soon became very generally trusted. [14] James the First of England was the first to perceive that this universally beloved and welcomed guest was a dangerous friend, and denounced him accordingly, and he made people pay dearly for the privilege of entertaining him.

This American fell into disgrace among the Italian clergy, [15] and Pope Urban, in 1625, issued a bull excommunicating all persons who should entertain him. [16] He was prohibited by royal decrees in Persia, Turkey, and China. Our [17] Puritan Fathers made laws against him, and forbade his coming to church. [18] But still this widely-travelled American had many warm friends who received and entertained him; and while much was written against him, much was also written in his favor. [19] Charles Lamb, in taking leave of him, writes:

"Brother of Bacchus, later born,
The Old World was sure forlorn
Wanting thee;

. . . .

"For I must (nor let it grieve thee,
Friendliest of plants, that I must) leave thee.
For thy sake, Tobacco, I
Would do anything but die."

You know that it is not his [20] beauty nor sweetness that has recommended him to kings, queens, and nobles; and you also know that he is not above associating with the humblest and vilest of mankind. [21] Tobacco comes of a bad family. Among his relatives we find the deadly nightshade, the horse-nettle, henbane, and Jamestown weed. [22] But he has some useful kindred. He is cousin to the pepper and the night-blooming jessamine, and second cousin to the tomato and potato. [23] There are many opinions as to how he came by his name, but there is no doubt that his name is Tobacco. As we know him, he is a black, disagreeable fellow, with a bad odor and a worse flavor. [24] One would imagine that if a person wanted to become an intimate friend of a family he would make himself especially agreeable at the first call; but Tobacco does just the contrary. As soon as he enters, the whole household is thrown into an uproar. All the servants unite to get rid of the guest, whom they recognize as an enemy of their dear master; [25] and in this effort the whole contents of the kitchen sometimes is emptied out at the front door, [26] and the general disturbance is so great that work in

the whole house may be temporarily suspended until the faithful servants can recover from their struggle with the foe.

[27] If Tobacco be admitted again and again the servants give up the struggle and tolerate the visitor, because the master likes his company, but they remove, as fast as possible, all traces of his presence, and say little; because being compelled to endure him, they learn to do it silently. [28] The lungs are busy throwing him out as fast as possible. [29] We know this because the breath is tainted with his poisonous odor; [30] the kidneys are overworked; the skin is saturated; and the bowels are sometimes thrown into slight convulsions (called "tetanic contractions") in their violent efforts to cast out the foe. Do you think foe is too strong a word to use? Wouldn't you think prussic acid a foe? Professor Bartholow, who is authority on such matters, says: [31] "The active principle of tobacco corresponds, in mode and intensity of action, to PRUSSIC ACID." [32] This active principle is called nicotine. [33] A single drop of it has killed a rabbit in less than four minutes. [34] If a dose large enough be taken, it will kill a man in less than five minutes, and it does not take such a very large amount. In using tobacco one does not get the clear nicotine, and that is the reason its bad effects are not more clearly recognized.

[35] Tobacco masquerades under different forms and different dress, but his personality is unchanged. His most universal character is that of a real home body. [36] He sometimes plays this part in the rough garb of a peasant or pioneer without any arts of adornment.

[37] In this coarse dress he sits down with the tired farmer, or cow-boy, and tells them wonderful tales of his goodness to them, his efforts for their happiness, and they listen while [38] he *steals* past Olfactory Sense, and dulls the other senses, and *cheats* the man out of the best of life, that is, the delight in being alive through and through. To be stifled, stunned, or paralyzed is not to live, even though the process may destroy the consciousness of pain or trouble. [39] But Tobacco takes great credit for his self-sacrifice, as he terms it; he is willing "to give his body to be burned" to promote the happiness of his friends. His first appearance in this character of a self-immolator, of which we have any record, was among his old friends the [40] aboriginal North American Indians, where he burned in the calumet or pipe of peace. [41] And it is in the pipe that he appears in his character of benefactor to the greatest number of people.

Tobacco knows well how to adapt himself to the company he is in. Humble and coarse among the ruder classes of mankind, [42] he puts on more style when coming among those more pretentious in dress and manners. [43] At home in the corn-cob pipe of the pioneer, or the briar-root pipe of the Indian, he is equally at home in the expensive brown-tinted meerschaum of the German prince, or the bejewelled *hookah* of the Indian nabob.

But, just as the actor under all disguises is the same, so Tobacco is ever the same in his characteristics, [44] and in the influence he exerts upon the master and the servants of the House Beautiful. He goes about the

premises doing mischief and blinding the eyes of the owner, or deceiving him with a recital of his good offices. [45] He burns the tongue and mucous membrane; [46] he changes the shape of the red corpuscles; he paints the façade an ugly yellow color; [47] he makes the cook unable to do his work well, and thus produces a disease called dyspepsia; [48] he stimulates the salivary glands to undue labor, and so wastes their power; he irritates the bronchia, and increases cough, if cough exist; [49] and sometimes that most terrible disease, cancer, has been traced to the use of the pipe.

> "Many and many a year ago,
> In kingdoms across the sea,"

[50] as well as in our own land, Tobacco was carried around in the pockets of his friends in little boxes. [51] He was then masquerading in the character of confidential friend or bosom companion. In this form he claimed to be exceedingly refined, and was admitted into the confidence of the most cultivated of both sexes. [52] Snuff-boxes were the usual gifts of kings and queens to each other, and were made of silver or gold and adorned with jewels. But even in this form Tobacco, true to his nature, did not disdain the common people, and in cheap boxes of tin or lacquer kept close by their sides, and won their confidence.

[53] I wonder how many of you know that the item of snuff enters into the annual expense account of the United States Senate?

There are probably few if any snuff-takers now in the Senate, but the fact that it was once considered of

so much importance as to be classed among the necessary expenses of the Senators, shows that it must have been generally used. [64] A public snuff-box stood by the table of the Vice-President, who presides in the Senate, and we are told that Henry Clay, in making his great speeches, was accustomed to pause, and, going to this box, deliberately take a pinch, and then returning to his place, proceed with his address.

[65] One of the effects of snuff-taking is to destroy the sense of smell. [66] Smell being deadened, Taste suffers likewise, for we have learned that Taste needs the aid of his twin-brother, Smell, to be able to form an entirely just judgment of things. Dyspepsia also results from snuffing.

[67] Another evil effect is the collection of snuff in the back part of the nose, called the posterior nares, cutting off communication between Olfactory Sense and the master of the house. Such a collection of snuff in the nose has been mistaken for a tumor. Snuff-taking is a habit that enslaves. [68] A snuff-taker without his snuff-box can not think, can not work, can not be happy. Like the Irish clergyman, he begins the day with the sentiment,

> "Before I budge an inch
> I hail Aurora with a pinch."

And during every hour of the day he says with the same writer:

> "Whate'er I do, where'er I be,
> My social box attends on me."

CHAPTER VII.

BAD COMPANY—TOBACCO A QUACK DENTIST.

TOBACCO not only plays the part of a bosom friend or that of a self-immolator for man's good, [1] but he styles himself a professional gentleman, and takes upon himself to act the part of a dentist. "Only give me a chance," says he, [2] "and I will preserve your teeth, and cure your tooth-aches"; and men believe him. [3] And women too are sometimes misled, and swab their mouths with snuff. [4] Tobacco is never so disgusting as when playing dentist. [5] No people except the Americans employ him in that capacity; Southern women "dip," and men both North and South chew. Not only is he disgusting, but he does more real mischief in that way than in any other. He does not keep his word. [6] He does not preserve the teeth, but in reality stains and discolors the enamel, weakens the gums, wears the teeth away, makes the breath bad, and, in short, he does so much damage, that if he were any other than a quack dentist, we would discharge him at once. [7] In addition to the evil which he does unaided, he takes advantage of the confidence which his employers have in him to introduce into the house other guests only less injurious than himself. Some of these are burdock

lampblack, sawdust, colt's-foot, plantain leaves, fuller's earth, lime, salt, alum, and many others. They are employed because they are cheaper, and they are almost as mean as tobacco.

[8] While Tobacco is pretending to be a dentist, he is quarrelling with the cook, irritating the salivary glands, and making them do extra work, and creating so much general disturbance in the household by his presence that the master [9] suffers with dyspepsia and probably from sleeplessness, low spirits, nightmare, gloomy forebodings, fear of death, pallor, emaciation, dizziness, rush of blood to the head, palpitation of the heart, and a host of other horrors, and all the while Tobacco is saying, "I am so sorry for you; but I am your friend. [10] See how I calm you, and rest you, and comfort you." And the poor devotee believes this false friend, and remains under his evil influence. If he would give Tobacco permanent leave of absence he would soon find himself relieved of all his domestic difficulties. The servants glad to be rid of such a tyrant would again work harmoniously.

[11] Wherever Tobacco is employed he puts up a sign: "Tobacco is dentist here!" [12] It can be read in the snuffy skin, in the disagreeable breath, discolored teeth and flabby gums. As with all dentists, his work speaks for itself.

[13] In the matter of expectoration of tobacco-juice, America has a world-wide reputation. [14] It has become a measure of public safety to provide in public places spittoons of enormous dimensions, and the [15] senatorial *cuspidore* is now more an object of Gov

ernmental importance than the public snuff-box. Not only does the cuspidore assist (in the French sense of the word) [16] at the grave and weighty discussions of legislative bodies, but finds a place in elegant homes and even in the pulpit.

[17] It is said that cannibals will not eat the flesh of a man who used tobacco, it is so tainted with it. Therefore, if a man expects to be killed by cannibals, and cares whether he is eaten after death or not, he might secure himself from such a fate by soaking himself in tobacco-juice. But I have never heard that cannibals hesitate about killing a man because he uses tobacco.

The success of Tobacco, in his capacity of dentist, is in inverse proportion to his promises. [18] Like some other dentists, he claims to be a medical assistant, and there is quite a long list of diseases which he assumes to cure.

This is an age of nervous diseases. Every physician knows that they are rapidly increasing. Tobacco says, [19] "I can cure nervous troubles"; and the sufferer trying it, and finding himself, for the time being, suffering less, believes that Tobacco has cured him. What he has done is to [20] paralyze the nerves so that they can no longer complain. He claims to cure spasmodic diseases, and yet we find spasmodic troubles directly traceable to the use of tobacco. To employ Tobacco as doctor, is not applying the hair of the dog to cure the bite, but getting him to bite you again in the same place.

"Tobacco," says one man, "causes seventy kinds of disease. [21] It kills twenty-five per cent. of the

vigor of the country, and damaging this generation injures the next." Some of the [22] diseases traceable to tobacco, are ulceration of the tongue, lips, tonsils gums, mucous membrane of mouth and pharynx; constipation, loss of appetite, palpitation of the heart, neuralgia, dizziness, trembling, loss of manliness, general debility of the nerves, deafness, loss of memory, mania, palsy, apoplexy, disease of the liver, and dyspepsia. A peculiar influence is exerted on the glands of the throat and tonsils." [23] Dr. Richardson says: "I once examined the throats of fifty smokers of different ages and habits, and found in them the enlargement of tonsils so common, and the other appearances so marked (that is, the redness and dryness of throat) that I think I could detect an immoderate smoker by these signs alone." He also says, "The smoker's sore throat is more easily induced by the use of cigars than of pipes, and when established is *incurable so long as the cause which excited it is allowed to continue, but soon disappears when the cigar or pipe is laid aside.*"

[24] This condition of throat creates a feeling of thirst, to satisfy which many a man is led to the use of strong drinks.

Cancer of the lip is often induced in persons who smoke short pipes, breaking out at that part of the lip whereon the pipe presses. [25] Smoking interferes with the heart's power of contraction, it being to a certain extent paralyzed. In inveterate smokers the pupils are dilated more than is natural. [26] In reading, the letters become blurred, sometimes bright images

or specks float before the eyes. A sure test of the injury done by tobacco, is in the impression made upon the retina, by means of which an object will be seen long after the eye is shut, or the object itself has disappeared. Richardson gives an instance of a man who could retain an image of a bright object as long as six minutes after the eyes were withdrawn from it. [27] I have frequently seen Professor Galazowski, of Paris, examine with an ophthalmoscope the eyes of strangers who came to him for treatment, and, without asking a single question as to their habits of life, he would indicate those who were accustomed to use tobacco to excess. This he was able to do by observing the changes made in the nerve and retina of the eye.

[28] Indulgence in tobacco also affects the sense of hearing, causing confusion of sounds with an inability to appreciate distinctly sounds either very soft or very loud. After a time, another symptom will be a sudden, sharp ringing in the ears, like the ringing of a bell, or the whistling of the wind; this may last some minutes and may be accompanied with giddiness.

[29] The nicotine of tobacco affects both the voluntary and involuntary nerves. It excites the motor nerves, and causes muscular agitation, followed by temporary suspension of action and paralysis. It excites the involuntary nerves, and produces muscular spasm followed by loss of power. This is what produces the pain in the stomach, spasm and vomiting, and the palpitation of the heart. [30] Tobacco affects

the glands of the system, exciting a free secretion and if the use become immoderate, the process of secretion may become incontrollable, because of a paralysis induced. [31] These are the opinions of the best physicians who have studied closely the effects of tobacco.

[32] Lizars says: "I have found that patients addicted to tobacco were in spirit cowardly, and deficient in manly fortitude to undergo any surgical operation however trifling."

[33] Professor Hinds has come to the conclusion that if the American people desire the highest perfection to which a race can be brought, they must renounce tobacco forever. But is it all a pretence then that tobacco is of avail as a remedy?

[34] Professor Bartholow says: "Tobacco is a severe and very depressing nauseant and emetic," and giving the diseases to which it is applicable as a remedy, adds always one of the following pertinent remarks: "It must be borne in mind that it is not free from danger." "Care must be taken not to introduce a lethal quantity, and so produce death by asphyxia." "It is so horribly depressing that the remedy may justly be considered as conducive to greater evil." "Its use is rarely justifiable." "We possess other remedies less dangerous." This is Tobacco's diploma.

CHAPTER VIII.

BAD COMPANY—TOBACCO AS A DUDE.

[1] THE "Dude" is a creation of these later days, and not to be behind the times, Tobacco also appears as a "Dude." [2] It is a character particularly attractive to juvenile minds, and boys, so young as not to be charmed by pipe or cigar, are captivated by the Cigarette. [3] Slight in figure, he seems to be too insignificant to be of harm to any one, and this apparent insignificance is his strong point. [4] "How can such a tiny fellow as I, do you any harm?" he asks. And the query seems to be such an absurdity that the only appropriate answer would be a smile. Let us see if this dwarf is as harmless as he would make us believe. [5] The fumes of the cigarette are drawn more directly into the lungs than those of the pipe or cigar, and the smoke of the paper in which they are rolled is an additional abomination. [6] Sending the smoke through the nose brings the delicate mucous membrane lining it, directly under the influence of the acrid poison, and catarrh is a result. [7] He is assisted by the vilest companions. Stumps of old cigars, and refuse of the vilest kinds, are incorporated into cigarettes.

[8] As the first effect of tobacco in all forms is to in

terfere with, and weaken digestion, [9] we can see at once that the effect on growing boys will be particularly hurtful, for in youth, growth, as well as repair, is a law of the system, and anything that interferes with digestion interferes with growth. The boy who smokes will not be as large, or as strong, or as healthy as if he had not smoked.

[10] Girls in their youthful ignorance, and their natural love of gaiety, sometimes fancy that to smoke a cigarette is a harmless aping of masculine folly; and resenting, perhaps, Lamb's assertion that,

> "Roses and violets are but toys,
> For the smaller sort of boys,
> Or for greener damsels meant,
> Thou (tobacco) art the only manly scent,"

they claim the right to indulge in the manly perfume; but Tobacco shows no partiality for sex. [11] He smiles as sweetly on the feminine, as on the masculine, and under cover of his smile does them as much, or as some physicians affirm more, harm.

[12] Boys do not care particularly about their complexions, but perhaps they will listen to this from Dr. Bartholow: "A cigarette-smoking boy will not make a strong man. He will have impaired digestion, small and poor muscles, irritable temper, and a lack of capacity for sustained effort of any kind."

[13] "The growth of this habit is insidious, and its effects ruinous. The eyes, the brain, the nervous system, the memory, and the power of application

are all impaired by it. 'It is nothing but a cigar ette,' means really 'it is nothing but poison.'"

[14] The decision of the doctors is that it makes boys cowardly, and lacking in decision and courage. It interferes with ability to study. [15] In the Polytechnique school in Paris, the non-smokers were found to be always superior in their classes to the smokers. Out of 38 who smoked, 27 were found to be actually diseased from nicotine poisoning, and the minister of public instruction forbade the use of tobacco by pupils.*

[16] Boys, shun the "Dude."

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* An organ of the liquor and tobacco trade says: "The tobacco factories supply for every male person in the country ten pounds of chewing, and three and a half pounds of smoking tobacco, and one-half pound of snuff. For the six million youths between ten and twenty years of age, six hundred million cigarettes, or one hundred apiece, are manufactured."

CHAPTER IX.

BAD COMPANY—TOBACCO AS A DANDY.

[1] THE character of Dandy is one of Tobacco's most successful personations. There are some who are fond of Tobacco at home in the pipe, but who object to appearing on the street with him in that attire; so he rolls [2] himself up in a cylindrical form, [3] calls himself a cigar, or *segar*, if he apes foreign airs, and becomes at once a dandy, and a so-called desirable friend. Gentlemen who pride themselves on being "mirrors of fashion," stretch out their jewelled hands, and take him up with a graceful twirl, which has been acquired by long practice, and strut forth, as Lamb says,

> "Bound in such a cloud
> That each man through the heightening steam
> Does like a smoking Ætna seem."

[4] The dandyism of the cigar seems to have blinded the eyes of some women and girls so that they permit smoking in their presence; or perhaps they make smoking-caps or tobacco-pouches for brother or friends without thought that they are countenancing an evil.

[5] Smoking promotes selfishness and even a disregard of the rights of others. [6] Air is our most important

food, but the man who, under no circumstances, would poison the water which another must drink, or the food that he must eat, [7] will not hesitate to poison with tobacco smoke the air which another must breathe. [8] The father, who would not put dust into the eyes of his child, or submit it to the fumes of sulphur, will take it in his arms and puff tobacco smoke into its face.

And in still more important ways does the smoker disregard the rights of others. [9] Emerson says, "A man's son is the son of his thoughts and of his actions," and asks: "How shall a man escape from his ancestors, or draw from his veins the black drop which he drew from his father's or mother's life?" The scientific men who have made this matter a great study, have found that a [10] weakened constitution is given to the children of tobacco-users. [11] One of them says: "In no instance is the sin of the father more strikingly visited upon the children than the sin of tobacco-smoking." [12] He goes on to enumerate the weakness of nerves, the depression of mind, producing melancholy and imagination of disease, the insanity, the dwarfing of the body, the suffering, the consumption and early death which are among the inheritances of tobacco-smoking parents.

[13] Dr. Elam says: "Children inherit the mental and moral characteristics and the acquired habits of their parents under a uniform law."

Dr. Richardson says: "As only our fathers smoke, so chiefly by our mothers is the integrity of the race fairly preserved."

[14] Tobacco under all disguises is a spendthrift. [15] It is in this character only that he fulfils more than he promises. The expenditure of money for that which does not bring a fair return is poor economy. The expenditure for that which is a physical injury is morally wrong. [16] Those who are friends with Tobacco are spending their money for that which is not bread, and their labor for that which satisfieth not. It has been stated that the American Church gives $5,000,000 a year to Foreign Missions, and $25,000,000 a year is spent by Americans for tobacco.

[17] The most moderate smoker will not spend less than $40 a year on his cigars. [18] A New York merchant says that by laying up the money that he would have expended on cigars, in thirty-nine years he saved $29,000. [19] Professor Hinds calculates that a young man, saving the money he would spend on tobacco and buying books with it, will, at the age when he should marry, have a nice library worth from $1,000 to $1,200; while the young man who has burnt his money as a sacrifice, not of "a sweet smelling savor," to Tobacco, will have nothing but a [20] diseased body to reward him.

[21] Insurance agents say that a very large percentage of losses by fire come from the spark of the pipe and the cigar.

[22] A spark from a cigar set fire to, and totally destroyed $3,000,000 worth of property. A match, thrown away after lighting a pipe, resulted in the destruction of a large printing establishment. Five blocks of buildings were burned, two thousand

employés thrown out of employment, and over $1,000,000 worth of property destroyed. A young man riding with a young lady was smoking; a spark from his cigar set fire to her dress and she was burned to death.

When I tell you, that the sheets, in which the corpse of a veteran user of tobacco had been wrapped, were saturated with a fluid like tobacco-juice which was poured out upon the surface of his body, to the amount of two pints, you will readily understand why cannibals will not eat such flesh, and you will be ready to admit that vermin will be killed by the water in which such a person has bathed.

I have now mentioned all the good qualities of Tobacco, and many of the bad ones. I will not stop to mention the evil influence he wields as a companion of the pulpit orator, nor of the odor (not of sanctity) with which he pervades the ministerial library; nor will I speak of the incongruity of the instructor of youth, teaching one thing and practicing another. But I would like to call the attention of the boys, who are ambitious of becoming men of importance and greatness, to the facts which prove that the friendship of Tobacco will be in every way a hindrance to the accomplishment of their worthy ambitions.

CHAPTER X.

WICKED COMPANY—THE QUACK DOCTOR.

[1] ONCE upon a time over all the earth were peace and prosperity. Men were strong and industrious, women were smiling and happy, and the laughter of children echoed through dale and over hill; their cheeks were plump and rosy, and their eyes sparkled with health and merriment, and the happy parents gathered around their hearths in sweet contentment. From palace and cot arose songs of joy, and in all the land there was not the shadow of a crime. The vineyards bore delicious fruits, whose fragrance filled the air. These fruits were food for man. With their acids they cooled his blood; with their sweets they filled his body with wholesome fatness and made the eyes of his children bright with health. Men picked the fruits and dried them, and thus dried they were wholesome food, capable of sustaining life and maintaining health.

[2] Abou Ben Hassan, wandering in his vineyard, found upon the ground a bottle from which came the beseeching voice of an imprisoned spirit pleading for freedom. [3] "Give me liberty, O most wise and potent prince," besought the spirit, "and I will be your most devoted slave. I have power both in earth and air.

The winds of heaven obey me, and will fan away from you the evils of the race. Your children shall be born under favoring stars. Poverty and sickness and care and crime shall recognize me, and bow beneath my yoke. The blight of fever will know my relieving touch, and the deadly chill will yield to my dominion. At your command I will return to my glass prison, and will only leave it at your request."

Abou Ben Hassan heard with charmed ears, but dared not grant the favor besought until he had consulted with his friends. To them he repeated the promises which had been made, and seeing signs of leniency in their faces, the spirit renewed, with even greater urgency, his plea for liberty.

[4] "I am *Al Gohul*, the Great. To me is given the power of bestowing gifts on man. I have been imprisoned by my deadliest foe, who wills that I shall not make known my wondrous powers. If you grant me freedom, I will foil his selfish plans. You shall never know storm nor blight; you shall never fear disease nor death; your glory and renown shall be my chief care; laughter shall fill your hearts, and joy dance attendance on your footsteps."

These words were vague to man, for as yet crime was unknown, and the faces of poverty and disease had been but dimly seen; but trusting in these promises, and lured on by the hope of fulfilling dearer aspirations for fame, Abou Ben Hassan and his friends opened the bottle and gave the desired freedom to the spirit, [5] who, creeping from his narrow prison, grew before their wondering eyes, rising like

a vapor and filling all the valley, spreading out over the plain like a dense fog, and towering above the mountains like a cloud.

Some would have been frightened that he grew to such a prodigious size, had not Abou Ben Hassan said, [6] "That is evidence of the truth of what he has told us. Did he not say that he had power? He will hide us from the eyes of our enemies; he will be a shield between us and harm."

And men believed and trusted the spirit Gohul, and he became a constant companion at their feasts and merry-makings, [7] and they were never so joyous before; the laughter was never so loud, nor the jest so mirth-provoking, as now that Gohul added to their wit and brilliancy. He made their tricks and pranks so ludicrous, and he seemed to knit the hearts of men into a bond of good-fellowship never felt before. [8] So sympathetic, too, was Gohul, that eyes all unused to weeping now shed tears, and hearts that were hard and unfeeling melted beneath his touch. He thus became a friend to the sorrowful; he soothed the grieving hearts of the mourners, and presided at the wailing ceremonies for the dead. [9] Men found that by his presence their intellects were stimulated to more brilliancy, and he was invited to inspire the poet and the priest, to aid the orator and the writer. [10] He annihilated fear, and was thus called a friend to the warrior, the scout, and the explorer. [11] He silenced pain, and men besought his presence at their bedsides when sick, and the dying blessed him for his soothing touch. [12] Physicians, finding him so

powerful an ally, called upon him often for assistance, [13] until at last he began to arrogate to himself the title of physician, and said, [14] "Did I not tell you that I would liberate you from evils? Have I not been true to my promises? See the glow upon the cheek of health. I give to wine the power to bring this healthful flush to the pale cheek of the invalid. It is I who make wine a cosmetic worthy of royal man who has descended from the gods. It is I who make of wine more than a cosmetic, who make it a cordial, giving courage to the heart and strength to the limbs. It is I who extract from herbs their healing virtues. Without me they would be of no avail. I even add to their powers, virtues of my own which are invaluable to man."

And the confidence of men increased in Gohul, and [15] they continued to grow in their intimacy with him. He was a guest at their tables, and even the women and children were fond of him. He presided at births and weddings, at christenings and at funerals. [16] Among men there was one who had never accepted the friendship of Gohul, who had always distrusted him to some degree, and who had employed his eyes in constant watchfulness over the life and experiences of those who were the associates of this spirit. His name was Observation. [17] He noticed that although children did not like Gohul at first, they soon grew to be very fond of him, and also that he was too rude a companion to be the most desirable friend for them. He overpowered their feeble strength, and made their feet tottering and unsteady, and Observation said: "It

is not best to become too intimate with Gohul in youth." [18] Again, Observation noticed that Gohul was not the wisest friend for delicate women, for sometimes, under his influence, they forgot to blush at unseemliness of conduct in others, and acted unwomanly themselves, and he called the attention of men to these facts, and some said: "Those actions which are right and becoming in men, do not suit the gentle modesty of women; we prefer that Gohul should not be intimate with our wives and daughters."

[19] He also noticed that there were men who could not associate constantly with Gohul because of their weakness; but these were laughed at as unfit to mingle in the strife for existence with the strong and manly, to whom Gohul seemed ever an indispensable assistant.

[20] Observation reported that Gohul was an enemy and not a friend; that diseases were on the increase, instead of being lessened; that because of him crime had sway in this once peaceful land; that he had put tears in the eyes of women, and murder into the hearts of men.

[21] These reports threw Gohul into a rage. "What [22] does Observation know?" cried he. "He has held himself aloof from my company. He is envious of my success. He is trying to take from you all that is dearest and most prized. I will not sit quietly by and see you so deceived, nor will I submit in silence to be so maligned. There are many among you who have experienced my healing touch, who have been soothed

by my sympathy, inspired by my presence. [23] I demand an investigation. Call together the men who know me, and let them testify whether I am an enemy." This proposal seemed but just, and it was decided that Gohul should not be condemned unheard. [24] Gohul demanded that a committee of investigation should be appointed from those who knew him personally. But Observation said: "That will not be just. [25] These are all prejudiced. We should have in this committee those who are unbiased."

But Gohul would not consent to this, and it [26] was at last agreed that all the committee should be selected from the acquaintances of Gohul, with the exception of one, whom Observation might select.

[27] The committee consisted of the wise men, teachers, and physicians, and the one whom Observation had selected, Madame Science. [28] Much time was spent in examining the various witnesses.

This committee like other learned committees could not agree, and [29] a majority report was first submitted.

MAJORITY REPORT.

[30] Your committee have the honor of reporting that Gohul is personally known to them, that he has long resided among us, and has been well and favorably known. He has been the trusted and esteemed friend and adviser of our best and wisest men. Our honored judges have admitted him to their inmost counsels; our ministers have been inspired by his spirituality; our legislators have welcomed him at their delibera

tive assemblies; the executive branch of our government has received from him efficient aid; he has enlivened the feasts of royalty, and his brilliancy is manifested in the lucubrations of the poet. He has not disdained the poor and lowly; he has been a universal comforter in sorrow; he has alleviated the sufferings of the sick; he warms the freezing; he cools the burning brow of fever; he stimulates the heart; gives strength to the feeble, and supports in the absence of food. He is especially valuable to the physician, and we find that he has been to man all that he has claimed to be.*

Respectfully submitted,

Drs. HAND AND GULP, *et al.*

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* Dr. Cartwright, of New Orleans, writes in the Boston *Medical Journal* concerning the effect of tippling upon the medical profession. Some thirty years before the time of his writing he went to Natchez, Tenn. Within a radius of fifteen miles he found only seventeen temperate doctors. A much larger number were tipplers. In 1823 the average age of the temperance doctors was thirty-four years, and the five that died, each lived to be from sixty to seventy-five years of age. Two only of the tipplers lived to be gray, and they were partly temperate. All are long since dead, and their average of life was less than thirty-five years. Those who took their drinks upon an empty stomach did not reach thirty years of age. They generally died before they had been practicing ten years. Sixty-two physicians settled in Natchez between 1824 and 1835, and of these, thirty-seven were temperate, and twenty-five were tipplers. Of the former, twenty-eight are living; and of the tipplers all are dead except three, and they have moved away. Thus we see that those members of the medical profession who sing the praises of alcohol, and who

[31] MINORITY REPORT.

By Madame Science.

[32] Truth compels me to dissent from the majority report. [33] I have employed my faithful assistant, Chemistry, in making this investigation, and [34] I find that the accused, who is known to you as Gohul, is one whom I have long known as Alcohol. [35] He is the offspring of decomposition. [36] When any fruits are crushed together in a mass, exposed to warmth and air, that form of decomposition takes place which is known as fermentation. In other words, it is a process of rotting. [37] When the fluid is separated from this mass, fermentation continues until, as it is claimed, it has cleansed itself, and a clear liquid results. This is known as wine, and is made chiefly of water and alcohol. [38] The different varieties of wines are made from different kinds of fruits. The flavors differ according to the kinds of fruit used, or to the different substances used for flavoring.

[39] To increase the strength of the wine, sugar is added before fermentation. Where the sugar is all used up before fermentation ceases, the wine is sour,

practice as they teach, suffer the same penalty as the most ignorant man who indulges in poisonous drinks.

Did the doctors live in vain? They taught what was not true, and for practicing as they taught they paid the penalty of death. They assisted Science to demonstrate that Alcohol, under all forms, is a poison, and that it murders its own friends. But is such aid to Science a sufficient evidence that an educated man has not lived in vain?

and is called a "dry wine." Where it is not all used up the wine is sweet, and is known as "fruity."

[40] Wine is injurious according to the amount of alcohol which it contains, [41] and even home-made wines have a certain percentage of alcohol. I find that Alcohol is not the friend to man that he has claimed to be. [42] He has deceived mankind by sophistries.

[43] He has not been a true friend to the sick and afflicted, but has, in fact, deceived the physicians themselves, causing the diseases which he has pretended to cure. [44] He is a quack doctor and leads to quackery. The statements of those who are influenced by Alcohol ought never to be received as testimony upon this subject.

Respectfully submitted,

MADAME SCIENCE.

[45] When this report was received Al Gohul laughed and boasted of his vindication. "Did not the majority report in my favor? [46] Who is this insignificant, unknown, unfeeling, and cruel Madame Science? She is never met in legislative halls, the best and wisest are scarcely upon speaking terms with her. She is seldom admitted to the best society. She is not witty, nor brilliant. [47] She is a plain, plodding person, who in truth is indebted to me for valuable aid, which she is not honorable enough to acknowledge."

[48] And men joined with Gohul in the laugh against Madame Science, and her report was laid aside and by his friends forgotten.

CHAPTER XI.

WICKED COMPANY—THE SHYSTER.

[1] OVER the rolling prairies, and up the sunny hill sides climbed the golden grain, smiling in the light of day, and waving in the rollicking wind. The corn was whispering of merry-makings, and of food for hungry men and cattle; the wheat was dreaming of bread in abundance for all; the rye was boasting of its wealth of strength for babes and mothers; the sugar-cane smiled as it thought of the sweets to be taken from its stem for the delight of young and old; and the potato called from his underground bed that he, too, had food for all. [2] Gohul looked abroad, and beholding so much of good, whispered to himself: "Would that I could turn this store of health into a source of disease and misery."

[3] Then he crept into the hearts of men, and murmured pleasing tales of how wisdom, and strength, and long life, and joy could be forced from the wholesome grains, and they be made more truly the servants of man, to minister to his delight and wishes. [4] And men listened and believed, and took the ripe and health-giving grains, and extracted the juices, and subjected them to fermentation, and said: [5] "Now we have liquid bread that will keep for years. It will give us health and strength; it will soothe our

pains; it will cheer us when sad, it will rest us when weary; and we can give it to our children without harm." [6] And the wicked spirit laughed at the evil he was about to do, but he kept out of sight of men. Disguising himself, and appearing under [7] a new name of Beer, [8] he denied that he had any acquaintance with Gohul, or Alcohol, adopting the name given by Madame Science. [9] He even admitted that Alcohol was injurious under some circumstances, but *he* had none of the evil effects of that spirit. *He* never brought men to lie in the gutter, but instead he nourished the young and the old, he nerved the arm of toil, he gave food to the hungry, and joy to all. [10] He was no longer a fine aristocrat, with a sparkling eye, and a lively mien. He was a jolly, red-faced fellow, with a big, corpulent body and swaggering air. His face was streaked with red lines, his eyes were dull and sleepy-looking, and his step was heavy and slow. [11] Sometimes he sat for hours doing nothing, thinking of nothing. He ate enormously, and [12] loved the society of a certain blackamoor named Tobacco. [13] And he said to men: "See how fat and jolly I am. See how little care I have. If you are my friends I will make you like myself. If you do not sleep well, I will give you sleep; if you have pain, I will silence it; if you eat more than the cooks can manage, I can force them to do more work; or if they can not dispose of the surplus, I can whip up the kidneys to get rid of it. And not only that, if you have poverty, I can make you forget it; if you are hungry, I will be food for you; if you are sick, I

will cure you. I can make you happy, without a cent in your pocket, and with your family starving around you and crying for bread. I am an honest, sympathetic companion, who cares not that you should be rich or fine. I will come with you to the humblest or lowest places, and will bless the beggar as readily as the prince."

[14] And for many years men believed these promises of Beer, and made him a household friend and companion. In the field and shop he was welcomed as a helpful friend. Mothers sought his aid, and gave their sanction to his association with their children. [15] Wise men, who grieved over the evil wrought by alcohol in wine, now said: "Beer is good. Let us invite him to sit at our tables and be our daily companion. He will cure the evils wine has wrought."

For men had at last learned that [16] wine caused a strange disease that made them weak, and stagger when they walked, that made them fall into the fire and the water, and awakened many evil passions, such as anger, and hatred, and murder. [17] And they believed that Beer had no such evil influence. They said: [18] "Beer is a cure for drunkenness." And Beer laughed jollily, and said: "Yes, yes, I cure drunkenness." [19] But Observation noticed that drunkenness did not diminish, and all over the land were women with breaking hearts, and children suffering with cold, and hunger, and neglect. [20] And again he called the attention of men to these facts, and they [21] said: "How is this? we use only beer, and yet men are dying with this disease. Where is the dreadful

cause?" The people hearing these reports, and seeing these deaths, and knowing that drunkenness, disease, and crime were increasing, [22] called for an investigation, and a committee was appointed to search out the hidden cause.

[23] This committee, made up of wise men, and physicians, and Madame Science, came together, and examined witnesses, and rendered their reports. [24] This committee was evenly divided.

[25] REPORT IN FAVOR OF BEER.

Your committee was evenly divided, and we therefore have the honor to report, that after having examined numerous witnesses we find that [26] beer is used by all classes of men, and especially by the workmen, who are unanimous in the belief that it is a food. The testimony of all who use it is that, when taken with their meals, it increases their appetites, and aids their digestion, and at the same time enables them to live on a less amount of food. It also soothes pain, and makes them forget their sorrows. It is prescribed by the oldest medical practitioners in all cases of debility. The small amount of alcohol that is found in beer is not prejudicial, but in fact is beneficial, being consumed in the body, and therefore is indirectly a food. There is therefore no reason for the fanatical outcry against the use of Beer.

Respectfully submitted,

[27] Dr. WISEACRE,
Professor SWELLHEAD,
Rev. ESAU TIMESERVER, *et al.*

[28] REPORT AGAINST BEER.

This branch of your committee have the honor to report that, after examining many witnesses, we find the following facts: [29] That the people have been deceived, for alcohol is truly to be found in beer in all of its forms. In ale, and porter, and stout, it is from eight to fifteen per cent., while in beer it varies from three to ten per cent. Like wine, these fluids are injurious in just the proportion in which alcohol is found in them.

[30] We have called in Chemistry, [31] who has explained to us the process of making beer. [33] The wholesome, healthful grain is soaked in water until it sprouts; this turns the starch to sugar. When it has sprouted sufficiently [34] it is dried so rapidly as to kill the germ. [35] It is then ground, and warm water and a bitter herb are added. [36] It is then boiled, yeast is added, and the whole mass is allowed to rot. [37] This is the same process of decomposition known as fermentation. [38] Sugar is changed to alcohol, and carbonic acid gas is formed, and rising to the top makes a froth, so that when the cork is taken out of the bottle it appears to boil out. [39] The hop is added to keep it from spoiling, and its bitter is a stimulant to the appetite. [40] During the process of fermentation the beer is put into barrels, or bottled. [41] Stout, ale, and porter are similar to beer, except that they contain a larger percentage of alcohol. [42] The evils of these drinks are often increased by adulterations. [43] Chemistry finds in beer some of the deadliest poisons,—arsenic, strych-

nine, ignatia amara, tobacco, nux vomica, opium, and especially cocculus indicus.* [44] This last-named drug claims attention on account of its general use. It can produce death, and when not taken in fatal doses still gives rise to serious symptoms,—such as unpleasant taste after drinking, burning in the throat and stomach, weakness and partial paralysis of the lower extremities, nausea and frequent vomiting, stupor, and sometimes convulsions.

[45] Beer is often poisoned by passing through brass faucets, verdigris being formed by the action of the acid upon the metal.

[46] "The effects of beer upon the habitual beer-consumer is known by his obesity, his flushed face, embarrassed breathing, puffy hands, and yellow conjunctiva. [47] He is usually short-lived, and the end is reached by hepatic and cardiac disorders. The use of malt liquors sets up fatty degeneration of various tissues, notably of the liver and heart."

[48] Through the action of alcohol, the nerves which govern the size of the capillaries are paralyzed, and they become distended with blood. [49] The immense quantities of beer required by the constant thirst of the beer-drinker fills the system with fluid, and the veins are full to repletion. [50] These two facts, the distension of capillaries and the watery state of the

* Two men in Ithaca, N. Y., in the spring of 1884, died suddenly after drinking a glass of beer, put up by the Ithaca Beer Company. The second one died while the *post-mortem* was being made upon the first. The symptoms in both cases were those produced by cocculus indicus.

blood, unite to make the face full and red, a color that, in this instance, is not one of health. [51] The same conditions are the cause of the "swell fronts" with which the House (no longer beautiful) becomes deformed. The stomach is distended enormously, and the liver is increased in size almost beyond belief. [52] A liver ordinarily weighs about four pounds, [53] but the liver of a beer-drinker has been known to reach the incredible size of fifty pounds.

[54] People often tell you of the wonderful health and strength of the beer-drinking nations, and point to their ruddy faces and corpulent bodies as an evidence of this. But we can now understand why their faces are ruddy and their bodies rotund; and when we investigate we find that they are not as strong as their looks would lead one to believe. They have not grown in muscle, [56] they have only stretched the body so that it will carry the refuse that the servants have not been able to get rid of. [57] The truth of the statement that this is waste matter, and not muscle, is proven by the fact that men who in youth were strong, have, as they increased in size under the use of beer, lost their strength.

[58] Physicians, both in Europe and America, unite in the declaration that beer, even in moderate quantities, taken steadily, is injurious to the health. [59] They dread to perform a surgical operation on a beer-drinker, for they know they can not calculate on his ability to stand the shock. [60] If he were an abstainer they could estimate very closely his chances for recovery, but if he is even a moderate drinker his sys-

tem may not be able to endure a very slight injury in addition to that which it has suffered from beer. [61] The unqualified testimony is that beer injures the digestion, produces dyspepsia, rheumatism, and gout. [62] One English doctor says he has often been able to cure rheumatism and gout, simply by inducing his patients to entirely abstain from their usual daily draughts of beer; [63] and of 1,540 cases of gout only one was an abstainer, [64] and his ancestors were beer and wine drinkers.

[65] "Beer is not food. Four hogsheads of beer are not equal in nourishment to one loaf of bread." [66] The beer-drinker is not soothed, but paralyzed; he is not fed, but poisoned; he is not cured of his maladies, but he is made diseased in every part, and "wears his heart on his sleeve bare to a death-wound, even from a rusty nail or the claw of a cat."

Respectfully submitted,

Prof. LIEBIG, *Chemist*,
Dr. BARTHOLOW,
JOHN BELL, *et al.*

CHAPTER XII.

WICKED COMPANY—THE THIEF.

[1] SOMETIMES Gohul was so strong that he no longer remained in his glass home, but burst its walls. [2] Seeing this, men exclaimed, in wonder and admiration, "Behold how strong is Gohul. If now we could add this strength to our own, there is nothing that we might not do," [3] and from this desire arose an effort to separate him from everything that might be a hindrance to his manifestation of strength. This was done, and he appeared [4] in a new guise, and was known as *aqua vitæ*, the "water of life."

[5] It was believed that in this form Gohul was a spirit sent from heaven to be the friend of man, and that to him was given power to cure all the ills of life, and even to preserve from death. [6] Not every one thus believed. There were those who thought him to be an evil spirit, but [7] his friends were still many and influential, and they were fierce in their partisanship, [8] and some of them devoted themselves to introducing him among the people abandoning all other business for that purpose. They formed themselves into large companies for the manufacturing of beer, ale, porter, and stout, and all varieties of wines, and especially for the manufacture of this newest

disguise of Gohul, the heaven-sent *aqua vitæ*. [9] These organizations of the friends of Gohul gave to the leaders wealth, and positions of trust, and honor, [10] and through his influence some of them became members of legislative bodies, and claimed to be public benefactors.

[11] Gohul was now happy. [12] He had obtained a foothold in the palace, the home, and the church; and in silence and darkness had done many deeds of mischief which the majority had failed to trace to him. [13] He had stolen strength from the strong, and increased the weakness of the weak. [14] He had dimmed the sparkling eye, enfeebled the strong right arm, [15] and stolen the cunning from the skilful fingers. He had deepened the rosy bloom of the cheek to a dusky purple, and [16] had added a flaming torch to the tip of the nose. [17] He had stiffened the supple joints, until they groaned with the pain of being moved. [18] He had dulled the brilliant mind and made the witty tongue to stammer; [19] he had spoiled the amiable temper, and despoiled the generous heart; [20] stolen the noble ambition of the young, foiled the undertakings of the middle-aged, and [21] brought disease and premature death upon men.

[22] But there were still many who were infatuated with him, who, having once come under the spell of his influence, were no longer able to exercise an unprejudiced judgment in regard to him. [23] By usurping control over the judgments of men, Gohul did them the greatest harm. [24] They became his blind, unreasoning followers, and this was the source of his

greatest power. [25] They called him king, and bowed down before him, and paid him homage, saying, "He is a spirit, we will have him to rule over us."

[26] Observation, who had ever kept a watchful eye upon those who associated intimately with this spirit, now asserted: [27] "Gohul is a thief and a robber; he [28] steals from men their health and strength; he steals from your children their food, and the covering off their poor emaciated bodies; he steals the happiness from your homes, the hope from the hearts of your wives, and his partisans have banded themselves together to steal your hard-earned gold. He steals your sense of right, and justice, and honor; he robs you of your sense of shame, of your courage, your manliness, and your paternal affection."

[29] These assertions were stoutly denied by Gohul's advocates. They [30] said, "It is only because men are weak that they do these things; a strong man will never be led astray." And they cried, "Look at me, I have associated with Gohul daily for many years, and I am strong, and well, and honest."

[31] But very many people agreed with Observation, and a great disturbance arose, [32] the opponents of Gohul contending that he should be banished from the country, while his [33] friends maintained that he was a law-abiding citizen, and contributed large sums of money to the support of the Government, and that his rights should be respected.

[34] And the people clamored for permission to vote upon the question of Gohul's being allowed to remain and have rights as a citizen. [35] But the friends and

partisans of Gohul defeated their wishes. [36] Then the people cried with a voice that was heard throughout the land, "VOX POPULI, VOX DEI": "THE VOICE OF THE PEOPLE IS THE VOICE OF GOD." "Are not we the people? [37] Is not the Government formed of the people, by the people, and for the people? Who then is this Gohul who robs the people of their rights? Listen to what we have been taught by Medicine, Chemistry, and Science."

Chemistry tells us, [38] "This *aqua vitæ* is not the water of life; it is *aqua mortis*, the water of death; it is obtained by fermentation followed by distillation." We all know that fermentation is a rotting process, [39] and distillation, which is called a refining process, does not change the properties, but increases the strength and injuriousness of alcohol.

From [40] the fermented products of rye, corn, and potatoes, whisky is distilled; from [41] molasses, rum; from the distillation of [42] wines, brandies are made. Chemistry [43] shows us that these are all largely adulterated with poisons, and also proves that liquors having the same flavors can be made wholly from drugs.

[44] Science echoes strongly the cry of Observation that Alcohol is a thief. [45] He begins his theft as soon as he is introduced into the system, biting the tongue, and stealing from the mucous membrane of the mouth its moisture, leaving it dry and corrugated. [46] He sets up a cry for water, a cry which he keeps up wherever he goes. Down the œsophagus into the stomach he goes crying "give me water," and [47] taking it from

all the tissues as he passes along. He steals it from the mucous membrane of the stomach, [48] producing an inflamed condition known as gastric catarrh, ulcerous patches, and finally a discharge of morbid matter tinged with blood. [49] Leaving the stomach, alcohol passes directly into the blood and is carried at once to the liver. [50] He is at once recognized as an enemy, and an effort is made to get rid of him. [51] This effort makes the liver at first grow larger, but at length, weakened by its long-continued labors, [52] it gets smaller and harder and has little knots on the surface, which constitute a disease known as cirrhosis or hob-nailed liver.

[53] Albumen is a necessary constituent of all of the tissues, but to be of use it must be in a soluble condition. [54] Alcohol hardens the albumen wherever they come in contact, and then it is spoiled for the purposes of nutrition. The albumen of the blood is hardened so that it can not pass through the walls of the blood-vessels to nourish the body. [55] Alcohol takes the water from the red corpuscles and leaves them shrivelled and hard, and with less capacity to take up the needed oxygen, sometimes making them cling together so that they can not get through the narrow halls of the capillaries. [56] Through the blood alcohol is carried to the kidneys, and they, too, make an effort to get rid of him, and they undergo fatty degeneration, the membranes of the kidneys lose their integrity, and that dreadful disorder, Bright's disease, is the result.

[57] Alcohol is an especial foe to the heart. [58] In

ordinary health the heart of an adult beats about 100,000 times in twenty-four hours, [59] each stroke raising nearly six ounces of blood, making [60] 600,000 ounces of blood in a day. It does this year after year during the whole of life. [61] It is stated that the daily work of the heart is equal to one-third of that done by all the muscles, [62] and that if its energy were expended in raising its own weight straight up in the air it would be raised to a distance of 20,000 feet.

[63] Alcohol causes the heart to work faster. [64] If a man drink but one fluid ounce of alcohol a day, his heart will beat 430 times more than it would without alcohol. [65] Eight ounces will make it beat about 25,000 times more than normal; that is, instead of beating 100,000 times in twenty-four hours, it will beat 125,000 times. [66] It is often said that two ounces of alcohol can be taken in a day without harm. [67] This is about what would be taken in a pint and a half of ale, or five glasses of sherry wine; but these two ounces of alcohol, evenly distributed throughout the day, will raise the number of beats of the heart by 6,000.

[68] This hurry of the heart is to send out of the system that which it recognizes to be a poison. But that is not the only reason of its haste. [69] The heart, at every beat, sends the blood through the arteries until it reaches the capillaries, where it receives a check. [70] It can not run so fast through these tiny passageways. The walls of the capillaries are firm and resist undue pressure of the blood, and it is therefore compelled to go slow. [71] This tonic state

of the capillaries is overcome by the paralyzing effect of alcohol upon the nerves, and the blood rushes through the capillaries with increased speed, [72] and the heart, feeling that resistance is removed, has no longer a guide to govern it and keep it beating regularly, and so, under the irritation it feels at the presence of alcohol, and the absence of the resistance of the capillaries, it runs faster and faster until the enemy has been driven out, and then it sinks down worn out and enfeebled.

[73] Medicine says that "many diseases that were formerly supposed to be benefited by alcohol are less fatal if alcohol is not used. [74] In case of general debility, and in convalescence from continued fevers, milk is found to be far preferable to any alcoholic preparation. [75] Physicians acknowledge that drunkenness has often been caused by following the prescriptions which contained alcohol." [76] And the women, who had been the greatest sufferers through the evils of alcohol, believed the statements of Science, Chemistry, and Medicine, [77] and banded themselves together to fight this arch deceiver, and prayed mightily to the Great Father of all, that they might be enabled to wrest the sceptre from his hand, and overthrow his dominion over mankind.

[78] Then a great tumult arose; the people were determined to banish Alcohol from the land, and to destroy his power; [79] and the rulers seeing this great commotion asked: "What is the cause of this disturbance?" [80] And the people replied: "Teach us and our children what are the crimes for which Alcohol is responsible."

CHAPTER XIII.

WICKED COMPANY—THE MURDERER.

HEARING this demand of the people, Gohul threw off his mask, and appearing in his true character exclaimed:

> [1] "'To do aught good never will be our task,
> But ever to do ill our sole delight,
> As being the contrary to His high will
> Whom we resist. If then His Providence
> Out of cur evil seek to bring forth good,
> Our labor must be to pervert that end,
> And out of good still to find means of evil.'"

[2] These sentiments, so boldly expressed, aroused a general feeling of indignation, and the [3] Government was forced to appoint a committee, to which was given power to send for persons and papers. [4] This committee consisted of representatives from the professional, moral, and scientific portions of the community, and the legislative and judicial branches of the Government.

REPORT OF THE COMMITTEE.

Your Committee have the honor to report that they complied most carefully with the instructions given them, [5] and have examined manufacturers of alcoholic beverages, and their books and their methods of preparing such beverages, and other parties

who were able to give information upon this all important subject. We have called on Madame Science, and she, after a long and careful investigation, reports as follows:

REPORT OF MADAM SCIENCE.

[6] "I find that whisky contains from forty to fifty per cent. of alcohol. That brandy has about fifty-five per cent., and wine from five to twenty per cent. [7] Beer has from three to eight per cent., while ale and porter are much stronger. [8] They are all harmful, according to the amount of alcohol they contain. [9] Alcohol is always a product of death and decay. [10] It originates in the decomposition or rotting of vegetable matter, [11] and for its production needs warmth, sugar, and moisture. [12] In the fermentation of grains the starch is changed to sugar, and this to alcohol. [13] The legitimate uses of alcohol are to be found in the mechanical and chemical arts; and there are those who assert that even in these it is not absolutely necessary. [14] It is always injurious to man. [15] I find that man is the only animal who desires any other drink than water, and I also find that [16] water is the only fluid which quenches thirst. [17] The desire for other drinks is abnormal. [18] ALCOHOL IS NOT A FOOD. It does not supply salts, albumen, caseine, fibrin, nor any of the substances which go to build up the body. It is not changed in the body. It goes in as alcohol and is eliminated as alcohol. It therefore can not be a food. On the contrary, IT IS [19] UNDER ALL CIRCUMSTANCES A POISON, [20] AND

A POISON WHOSE EFFECTS ARE CUMULATIVE. [21] If taken continually, even in small doses, it produces decay and leads to paralysis, and tends toward death. [22] It is all the more injurious because it works so insidiously that its evil consequences are often [23] not recognized, either by the victim or his friends until they are beyond repair.

"It saturates every tissue. The stomach, the spleen, the kidneys, the spinal cord, the liver, the lungs, and the brain are all [24] engorged with blood by its paralyzing influence upon the nerves which govern the size and tonicity of the capillaries. [25] After a time these changes, at first temporary, become permanent, and incurable diseases of these organs ensue.

[26] "Alcohol prevents the red corpuscles taking up oxygen, and as a consequence the lungs are affected. [27] The delicate membranes of the lungs are also hardened, so that osmosis is interfered with, and from this twofold cause, the [28] carbonic acid gas is retained in the air-cells, and returned to the system to poison it. [29] Every organ of the body is wrapped in a membrane. The bones have their *periosteum*, the muscles their *perimysium*, the intestines are folded in a membrane called the *peritoneum*, the brain wrapped in membranes, and so too is each minute cell and *fibrillæ* of the body. [30] Most of these membranes are filters through which the nourishment must pass to reach the tissues. To work perfectly they should be charged with water. [31] Alcohol lays his destroying hand upon those delicate membranes and abstracts the water, and they become thick and

hard, so that the nourishing part of the blood can not filter through to reach the tissues; or they become too porous, and allow the precious foods of the body to leak out and be cast away; thus depriving the system not only of health, but, little by little, of life itself. [32] The whole repair and growth of the body depends upon the integrity of the membranes. If they are too thick, they become loaded with foreign material and prevent repair; if too porous, the [33] fluids may accumulate in the closed cavities and dropsy be the result. [34] The engorgement of the cutaneous capillaries gives a feeling of warmth, but there is no actual increase of bodily heat. [35] On the contrary, the heat radiating from the surface creates a cooler condition of the internal organs. [36] This is demonstrated by the thermometer, which shows that in the various stages of intoxication there is a continual fall of bodily heat from one to three degrees. [37] It takes three or four times as long to regain the normal heat as it did to lose it; [38] therefore, there is a chilly feeling in getting over the effects of alcoholic poisoning called intoxication.

"The statement that alcohol checks waste is true. [39] We have already seen that it does not permit carbonic gas to be sent off through the air-cells, [40] but compels it to be retained in the system to poison it. [41] It hardens the membranes so that they will not allow albuminous materials to pass through, for the nourishment of the tissues; nor the waste matter to pass out from the tissues, [42] so that the body is filled with waste material which is wrongly called fat. [43] All

the processes of life are full of change, and anything which interferes with this change is injurious, because it interferes with vital action. [44] To check the ordinary waste of the system is to tie the body to its own corpse. [45] Alcohol is not a food, for it diminishes nutrition. [46] It apparently increases digestion by inducing a superficial congestion of the mucous membrane of the stomach, and a dilation of the arterioles which will ultimately produce gastric catarrh.

[47] "The delicate membranes of the nerves do not escape the shrivelling touch of alcohol, but are deprived of their moisture, and becoming hard and shrunken press on the nerves, causing neuralgic pains.

[48] "The power of the nerves to transmit messages to the brain is lost, and deadly injury may be done to a part of the body without the man being, at the time, aware of it. [49] Men, under the influence of alcohol, are frozen because their nerves do not warn them of their danger, and also because the brain can not control the working of the limbs. The brain is no longer governor. [50] The brain itself is partially destroyed by alcohol. All the principles of which brain matter is composed (with the exception of the albuminous framework) are soluble in warm alcohol, and the framework becomes hardened, so that the brain of a drinker not only actually decreases in size, but becomes hardened in consistency.

"The following is a partial list of the diseases caused by alcohol: [51] Inflammation of stomach, congestion of liver, diabetes, inflammation and palpitation and fatty degeneration of heart, gout, premature old age,

irritable temper, indecision, cowardice, rheumatism, asthma, pleurisy, atrophy of liver, fatty degeneration of kidneys, dropsy, Bright's disease, consumption, sleeplessness, epilepsy, neuralgia, apoplexy, inflammation of brain and spinal cord, paralysis, delirium tremens, moral perversion, softening of brain, idiocy, insanity, and madness."

REPORT OF EXPERIENCE.

We have also examined [52] Experience, and he reports as follows:

"I find that alcohol does not increase [53] a man's strength and working ability. Men who train as athletes have learned that they must avoid alcohol if they wish to be successful. I find that under all circumstances men can endure exposure and work harder under extremes of heat and cold; keep in better health and have sounder judgment, when not using alcohol, than they can when using it ever so moderately. In shipwrecks, in Arctic explorations, in long-continued exhausting labor, the advantage is always with the abstainer from alcohol. I find that [54] rheumatism, and other difficulties which are produced by alcohol, can often be cured by totally abstaining from it, without giving any other remedies. I find that even moderate drinkers are more susceptible to the influence of epidemics. [55] In Tiflis, a city of 20,000, in an epidemic of cholera every drunkard died. [56] I find that drinking men are never so sure to recover from surgical operations as abstainers. I find [57] that men who do not use alcohol, in any form

are much less affected by changes in climate than are those who are addicted to its use, and are not subject to the dangerous and troublesome diseases which affect the drinker. [58] I find that the majority of sunstrokes occur among those who use alcohol in some form; that a great number of the diseases and other ills from which men suffer are caused by alcohol; and that the [59] water-drinker loses nothing and gains everything."

REPORT OF HEREDITY.

[60] Heredity being inquired of in regard to the effects of alcohol upon posterity replies: [61] "I find that children inherit the mental and moral attributes of their parents, and I find that they especially inherit the acquired vices of parents. The Chinese recognize this truth and inquire not only into the facts of crime, but also into the temperament and physical habits of the accused, and of his ancestry, knowing that criminals beget criminals. I find that drunkards beget drunkards. [62] That the use of alcohol in a man produces physical and moral degeneracy in his posterity. Drunkards beget idiots. Idiocy is a manufactured article. Among intemperate people the children may seem intelligent up to a certain age, and then lose their minds. [63] I find that convulsive diseases, hysteria and irritability, are also inherited from drunken parents. Even if the child have not the same habits of the parent, it will have a faulty and defective organization. Of those who are well nourished otherwise, but who use alcohol, the children

may be weak, nervous, excitable, and prone to morbid conditions. But in the children of those who drink, not having sufficient food, the condition is still worse. I find that in thousands of cases where people being temperate have children, and afterward becoming intemperate, have other children, the latter become intemperate more frequently than the older children in a proportion of five to one."

REPORT OF ECONOMY.

[64] The testimony of Economy is as follows: "I find that the [65] production of alcohol destroys enormous quantities of wholesome food. [66] It employs men in a debasing business which deprives the honorable industries of the world of the service of many workmen. [67] I find that the making of alcoholic drinks is expensive, and that $800,000,000 a year is expended in the purchase of these poisonous beverages, [68] thus robbing families of money for food and clothing and other necessaries of life. I find that the drinkers of [69] alcoholic drinks lose much valuable time by drunkenness, sickness, and idleness; that lives are lost, [70] some by being shortened by the use of alcohol, others by the deprivation which has come through the use of alcohol by those who should have provided them with the necessaries of life, others by accidents which have occurred, directly or indirectly, through the use of alcohol. [71] I find that it costs the country vast sums of money to provide police to look after those who are accustomed to drink; to employ legal services in trials for crimes occurring through alcohol

in building prisons to confine criminals made such by alcohol; to build insane asylums for those who are made such, directly or indirectly, by alcohol; to build and maintain idiot asylums, poorhouses, institutions for vagrants and outcasts, who, if it were not for alcohol, would be useful citizens. I find that there are at least 600,000 drunkards in the United States. [72] I find that at least 60,000 drunkards die every year, [73] that 100,000 men and women under the influence of intoxicating drinks are sent annually to prison, and [74] 200,000 children to the poorhouse; that [75] 300 murders yearly are committed under alcohol, and 400 suicides; [76] that 200,000 orphans are yearly left to charity. [77] I find that it costs the United States $60,000,000 every year to support pauperism and crime caused mostly by alcohol."

REPORT OF MORALITY.

[78] Morality being questioned reports as follows: 'I find that in [79] drunkards the moral sense is especially perverted. I find that the use of alcohol removes, gradually, the restraints which [80] conscience or a sense of decency imposes. That man under the influence of intoxicating drinks does and says things at which, in his sober moments, he blushes. [81] His reason is perverted, and he is incapable of forming correct judgments on minor matters, and much more so on matters of importance. [82] This vitiation of judgment is the cause of many of the accidents for which alcohol is accountable. [83] In time of danger the captain of the vessel takes a drink, and his reason

being thereby impaired, he no longer gives judicious orders, and wreck and death are the result.

"The engineer who, when sober, is watchful and careful, under the influence of a slight amount of alcohol, becomes careless and foolhardy, runs his train into danger and causes great loss of life.

"Then I find that alcohol loosens the passions, and under its [84] influence the 'gentle'-man becomes a fiend, beating, cursing, and perhaps killing wife or child, and awakening next day to a knowledge of a crime which will fill him with remorse to the day of his death. [85] The statement of the grand jury of a great city is that nine-tenths of the crimes entered were due to alcohol.

"I find that because of the inexorable demands of the appetite of the drunkard for alcohol, and the immense gains accruing from [86] gratifying this demand, men's moral sense and love of humanity are so perverted, that they are willing to engage as a business in the sale of that which they know is putting an enemy into a man's mouth to steal away his brains; that which they are aware will take the bread from the mouths of starving children, and deprive wives of the care and protection of their husbands, and destroy every noble impulse of the man himself. I find that they are even willing to sell liquor to women and children, and that having made drunkards of them, they are not willing to bear the blame and expense of the results of their own labor. They turn the poor poisoned inebriate out into the street to freeze, or starve, or die, while they live upon

the proceeds of his toil, or from the pawning of the clothes of his children.

[87] "I find that women who use alcohol lose their charm of womanhood, that they are no longer modest, pure, and delicate, but become profane, immodest, lying in the streets without a blush, forgetting their helpless babes, caring nothing for home, or decency, becoming filthy, homeless outcasts and wanderers, criminals themselves, and inciting to crime.

"I find that children who use alcohol are as degraded as children can possibly become, and show marks of hardness and degradation, that it would seem impossible for a child to reach.

"I find that where alcohol is prohibited crimes are almost unknown. [88] A city of 10,000 inhabitants with no grog-shop, has but one policeman, and little use for him. Places of 3,000 inhabitants without liquor-saloons have neither police, criminals, nor paupers. In such communities I find nothing lacking because of the absence of alcohol. Health, morals, prosperity, happiness, legitimate business, religion, all flourish without the contrasting elements of vice, crime, indigence, insanity, incendiarism, fatal affrays, and degraded manhood.

"I find that [89] the use of fermented wine at the sacrament is often attended with serious downfalls of those who have striven to get free from the chain of the monster appetite, and I believe that the church which continues to use it, tampers with its moral sense, and with the temporal and eternal welfare of those weak ones who have committed themselves to the care of the church for help in a fearful struggle

for life, and also endangers the safety of the young who take their first sip of wine at the table of the Lord.

"CERTAINLY NO OTHER THAN UNFERMENTED WINE SHOULD BE USED AT THE SACRAMENTAL TABLE."

Your committee fully endorse all of the above findings, and they are fully satisfied that it would be better for the Government, and for the people, if the sale and manufacture of alcohol, for any other than mechanical and chemical purposes, were prohibited and abolished, and your committee believe that the Government, as suggested by the Supreme Court, has the power, under the Constitution, not only to regulate, but also to prohibit the sale and manufacture of alcoholic beverages. We would also call your attention to the fact that many of the so-called patent medicines, bitters, and hop bitters are often the most dangerous and deadliest forms of alcohol. We also concur in the opinions expressed by the medical profession that alcohol should be classed with the most dangerous poisons, never to be used except when prescribed by a wise and conscientious physician. Respectfully submitted,

DR. RICHARDSON, DR. BILLROTH, REV. TALMADGE, HON. BLAIRE, Judge DAVIES, *et al.*

The report of the committee is fully endorsed.

GOV. ST. JOHN.

When the report of this committee was made public, Gohul called together his followers;

"And round he throws his baleful eyes,
Mixed with obdurate pride and steadfast hate,

He views the dismal situation waste and wild;
No light; but rather darkness visible
Served only to discover sights of woe,
Regions of sorrow, doleful shades, where peace
And rest can never dwell; hope never comes
That comes to all; but torture without end.

And with bold words,
Breaking the horrid silence, thus began:
'What though the field be lost,
All is not lost; the unconquerable will,
And study of revenge, immortal hate,
And courage never to submit or yield,
And what is else not to be overcome;
That glory never shall their wrath or might
Extort from me.'

And thus answer'd soon his bold compeer:
. . . . 'To bow and sue for grace
With suppliant knee, and deify their power,
Who from the terror of their arms so late
Doubted their empire; that were low indeed,
That were an ignominy, and shame beneath
This downfall.'

Whereto with speedy words the archfiend replied
'Seest thou yon dreary plain, forlorn and wild,
The seat of desolation, void of light,
Save what the glimmerings of these livid flames
Cast pale and dreadful? Thither let us tend,
From off the tossings of these fiery waves;
There rest, if any rest can harbor there;
And, reassembling our afflicted powers,
Consult how we may henceforth most offend
Our enemy; our own loss how repair;
How overcome this dire calamity;
What reinforcement we may gain from hope;
If not, what resolution from despair.'"

CHAPTER XIV.

GOOD COMPANY.

THE wise man chooses his friends wisely. He does not invite as guests to his house those who are deadly enemies to his welfare. He does not consort with thieves and murderers, nor will he make intimate friends of those whose only recommendation is their power to amuse. He proves his wisdom by associating with those who are helpful to him, who bring strength by their presence, and encouragement by their truly helpful qualities. His friends are not chosen because of their fine dress or elegant manners, but for their sterling worth, their truthfulness, and their candor. The Man Wonderful who truly appreciates the glory of his beautiful house, and desires to keep it in perfect repair, a credit to himself, and an honor to its Great Creator, will keep aloof from the whole tribe of doubtful, bad, and wicked companions of whom we have told you. His guests will be workers, who will be selected for their special duties with a wise forethought. [1] If company were never received and entertained in the house it would soon fall into a ruinous condition and become uninhabitable. [2] But on every side we find stores of iron, potash, lime, soda, and all the substances needed to keep us in perfect repair. [3] The first guest who is invited to

enter the House Beautiful is called Milk. She is sweet, fair-complexioned, and attractive, and is welcomed with gladness. She deserves this welcome, for she brings with her [4] everything that is needed in the house. The lime and the soda, the fat and the sugar, all come in right proportions when brought by Milk.

The various guests whose help is needed in keeping the house in repair have very big names. There are the [5] Albuminoids, an important company of workers, who, in looks, resemble the white of egg. They form the greater part of the whole body. [6] They are found in both the animal and vegetable foods, and have different names according to their location. [7] In the blood they are called *fibrin*, and are the substances which are hardened by the touch of alcohol and thus are rendered incapable of passing through the membranes and doing their work. In wheat these albuminoids are called *gluten*, and in milk they are called *caseine*. [8] Milk is the most perfect of foods.

As a certain writer says: "Nature folds us in her arms and feeds us milk." [9] Even our solid food is made up of the same material as was the milk which nourished us as babes.

[10] The next guest who is invited into the house is a pale individual, we might almost say insipid, but very important. His name is H_2O, but he is very willing to be known by his common name of Water. Would you believe that your [11] body is about three-fourths water? [12] that even the bones are one-eighth, and the brain two-fifths water? [13] This proves that Water is a valuable friend and should receive a kindly

welcome. [14] We need to take about three pounds of water every day. But do not imagine that we have to drink so much. [15] Everything we eat is largely made up of water, and if we did not drink at all we should still take a good supply of fluid into the system.

[16] Even beefsteak, which we are accustomed to think of as solid food, is three-fourths water, while parsnips and turnips are nine-tenths water. [17] Fruits are flavored and sweetened water, but they have other work to do besides furnishing a pleasant drink. [18] They contain a certain proportion of muscle-forming material, as well as sugar, when they are ripe. When unripe they contain much starch, which the sun changes into sugar. But this is not all. [19] Fruits have certain acids which unite with other materials in the system, and produce the carbonates and phosphates of lime, and the carbonates of soda and potash. [20] These we know are needed in the bones, so that we may learn from this that fruits are good company, especially for children, who particularly need such bone-making substances, and who may have the calcareous material in their systems, but it can not be used because it needs the acids of the fruits to set it free; this being done they unite with the acids and form the phosphates and carbonates for which the bones are continually calling. [21] It needs only a small failure in bone-forming material to produce the disease called rachitis, or rickets.

[22] "No thought without phosphorus," say the Germans. And so the Man Wonderful asks, [23] "Where

shall I find this necessary friend of mine, for I must think?" [24] He has learned that lime and iron and potash and phosphorus are in the soil, but he has also learned that he can not use them in the form in which they exist in the soil. They must be made over, for his use. Who then has made Phosphorus over so that he can become a welcome guest to the House Beautiful? Ah, [25] man has some very obliging neighbors. They eat the minerals from the soil, and he [26] in turn eats them. It seems like base ingratitude, doesn't it? Holland, in his beautiful poem of Bitter-Sweet, says:

"Life evermore is fed by death,
In earth, or sea, or sky,
And that a rose may breathe its breath,
Something must die.
The milk-white heifer's life must pass
To feed thy own,
As fled the sweet life from the grass
She fed upon."

[27] The vegetable and animal world are the obliging neighbors who prepare our food for us. [28] The plants take from the soil the minerals and assimilate them, that is, make them over into their own substance, changing the inorganic materials into organic forms.

[29] Inorganic materials are those which have no organs, and grow by adding like materials to the outside. [30] Organic substances are those which have organs, and grow by taking food into themselves, and assimilating it. [31] Plants and animals are organic, [32] but they differ in this, that plants can live upon inorganic materials.

[33] Phosphorus is an inorganic substance, and is found in an organized form in both animals and vegetables, but especially in the germs of grains. Therefore [34] wheat, rye, barley, and oats are good food for thinkers. Man is the animal who thinks and reasons, say some who wish to mark the distinction between man and his quadruped friends. "Man is the animal who laughs," say others. There is one thing which truly distinguishes man from all other animals. Man is the animal who cooks his food. Experience has taught us that heat ruptures the starch cells of food, and thus enables us to bring the starch into quicker contact with the fluids which act upon it. [35] All grains need long cooking in order thus to rupture the starch cells.

[36] Rice, tapioca, corn-starch, and such foods are not suitable as diet for babies, because infants have no saliva. [37] Their salivary glands are not developed until they have teeth. [38] And as these foods are largely starch they need the action of the saliva for their digestion. [39] Starch is known under the name of amylaceous food.

[40] Next come the saccharine foods, which are guests most heartily welcomed by the little people who are said to have a "sweet tooth." [41] We find sugar in nearly all foods, and we find it as sugar in the sugar-bowl. [42] It is made from the sugar-cane, from beets, and as some of us know by delightful experience, it can be made from the sap of maple trees. It is found in corn, wheat, rye, milk, figs, peaches, in fact in all grains and fruits, so that if we never went to the

sugar-bowl we should still be eating sugar every day.

[43] The oleaginous or oily foods come next. Some young folks are very fastidious, and do not like these greasy fellows, and say, "I hope they are not necessary company." Fortunately for those who do not like fat meats we can obtain fat elsewhere. [44] Nuts are about half oil, and butter is largely oil. Fat exists in all vegetables and grains, so you are eating fat when not aware of it.

[45] Starch and fat are consumed in the production of heat and energy. [46] They are our engineers, [47] while the other substances may be called our busy builders. [48] The food we eat should be suited to our age, health, habits of life, and the season of the year.

[49] The food of the child should consist of less animal food than that of the adult. The invalid should consult the state of his digestive organs. [50] The sedentary man should not eat as much, nor the same kind of food, as the laboring man, and in winter we may eat more fatty foods than in summer.

[51] The youth who comes from the active, outdoor life of the farm to the school should change his diet with his habits, or he will lay the foundation of a future dyspepsia. [52] The question of what we shall eat is one that deserves our earnest study and thought. The bountiful Giver of all good has in this our native land, placed at our hand the greatest variety of wholesome foods from which to choose. [53] He who makes the wisest choice will reap a reward in health, and in ability to enjoy.

The food we eat must with the sunshine glow,
It must be filled with pure life-giving light;
It must have drunk the very air of heaven;
Through it, the universe must work in us,
That each and all of us may truly live.
So nature with an ever liberal hand
Pours forth the treasures of both land and sea,
To give to man a wide and vig'rous life,
Participant of all variety.
Freely for him the palm, the date, the pine,
Wheat, rye, oat, maize spread harvests to the air
Apple, plum, peach invite his ready hand.
Beneath his feet lie stored the sugary beet,
The starch of the potato, while all space
Is rich with juicy, all-inviting herbs.
The solid flesh of bird, and fish, and beast,
As victims for the sacrifice prepared,
Wait ready to make firm the arm of toil,
Or, in the brain-cells light the torch of thought.
Eat and be merry. Let earth's varied life
And power be marshalled in its ruler's breast.

CHAPTER XV.

THE ROYAL GUEST.

AMID my morning dreams I heard a soft
And gentle tapping on my window-pane,
And, raising on my elbow, strove to break
The filmy band that Sleep had woven soft
Across my eyelids, while I, through its veil,
Beheld a dim and shadowy form, with robes
Wind-blown and fluttering in the misty air,
And heard against the pane the ceaseless beat
Of slender fingers, urgent in demand
For entrance to my sheltered domicile.
"Who art thou, then, impatient stranger, who
All uninvited seek'st to enter here?"
A voice, like chimes of crystal bells, replied:
"I am a king, and thy most helpful friend."
I, doubting, answered querulously back:
"If thou'rt a king, why com'st thou not in guise
Of royalty? Why at my window-pane
Demand admission? If thou art a king,
Over what mighty realm dost thou hold sway?"
Again the crystal tones made sweet reply:
"Three-fourths of earth to my dominion yield;
Without me were not ocean, lake, nor stream,
Nor thund'rous surges of the mighty deep,
Nor gurgling music of the tireless rill.
Without me earth were one vast, arid waste,
With no oasis cheering longing eyes;
No tender leaf would bud, no flower would bloom.

Here were I not, King Sol would scorch the plain
And melt the very earth with fervent heat.
But now my power doth stretch a canopy,
A thin and mottled, gauzelike awning, placed
Thee, and his far too-ardent gaze between.
Without me ne'er would heaven's cloudy hosts
March valiantly across the azure field
To sound of thunder's martial music, nor
The blessed fusillade of rain-drops fall,
To raise, not blight the drooping heads of flowers.
Without me would the mountain's hoary head,
Uncapped with brilliant whiteness, rise aloft,
Bald, dreary, desolate and all uncrowned.
Without me would no glacier rivers send,
From their deep hearts, the mountain streamlet down
To cheer the thirsty vales waiting below.
I am the teeming heart's blood of the world."

"O, mighty king," I hastened to respond,
"If thou so vast, so wondrous, so divine
A kingdom hast, why humblest thou thyself
To beg of me admission here? What gift
Have I to offer monarch so august?"
"My simple child, 'tis I who come to give.
I bring thee health, and wealth, and food, and life.
Dost thou not know that three parts of thy House
So Beautiful belong to me? That I
Myself do humble, truly thee to serve?
Thy Housekeeper I ever walk beside,
Her parcels carry, open wide the doors
Which she would pass through, and which, but for me
Would never open; sweep from every nook
The tiny particles of waste that check
Her progress, and disdaining not the toil
Of humblest menial, keep thy dwelling clean.
Closed were thine eyes to all dear sights did I

Not dwell within their orbs. Dead, dead were Taste,
And his Twin-Brother, were I to depart.
'Tis I who quench the thirst of arduous toil,
Who cool the burning heat of fever's touch.
With every friend who visits thee I come,
To aid his friendship; and with every foe,
To half disarm him of his deadly shafts
With which he aims to strike thy very heart.
King Alcohol, without me, would have more
And deadlier power against thee, but with me
Allied, he loses strength, and harms thee less.
And yet he loves me well, and calls for me
Where'er he goes, and by his love doth drag
Me forth against my will, to leave my work,
And join his baleful train of direst ills.
O child of earth, be wise, be wise in time,
And shut thy door against King Alcohol,
For he doth much degrade his royal name.
But I, *I* worthy am to be a king.
Look thou abroad upon the fields, and see
Each emerald leaf doth well proclaim me good.
I deck the world with verdure, gem with dew
The silken robes of flowers. I adorn
Thy wintry window with a filigree
Of crystal. With the brilliant rainbow-scarf
Of God's own promise do I gird the heavens.
My robes unsullied typify the truth;
My crystals, emblems are of purity;
My dewdrop-gems, the type of innocence.
Born of the earth, I yet ascend to heaven,
And from that glorious height oft I descend,
To bless, and purify, and save the world."

CHAPTER XVI.

THE MAN WONDERFUL.

WHEN we compare the inhabitant of the House Beautiful in his physical nature with other animals, we find that he far surpasses them. Born the most helpless of living creatures, through his manual skill he emulates all other animals in their most pre-eminent qualities. In his wild nature he subsists upon the fruits and seeds of plants, and the flesh of other animals. He is the most cunning of still hunters, far surpassing even the cat family, for with his swift arrow, or the ball from his unerring rifle, he reaches his game before they are aware of danger. As a trapper, he is more skilful than the spider, and he is not content with one kind of trap or one species of prey.

The speed of the greyhound and the scent of the foxhound, both together, do not make them so certain of following and overtaking the game, as his untiring pursuit and his keen observation of every broken twig, every overturned leaf, every crushed blade of grass left by the flying deer. Our numerous domestic animals prove that he tames the wild creatures of the woods and makes them serve him.

In order to have a secure means of subsistence, he has learned to cultivate the soil, and in every department of this industry he has demonstrated his superiority. Nature gave him only hands as tools, and

these none too strong; but with these he has devised and manufactured all kinds of useful implements and machinery for farming. He no longer digs in the ground unaided, but employs other animals to assist him, while the hoe, the axe, the plow, the harrow, the corn-planter, the wheat-drill, the sulky-plow, gang-plow, and the mower, reaper, and binder, and the thresher, all testify to his genius. Unable to breathe in the water, he yet constructs armor and machinery, by means of which he dives to the depths of ocean, and walks among the finny tribes apparently as much at home as they.

Discovering the force of gunpowder, he devises means of using it to blast rocks or to destroy his enemies, and with the forces of nature obedient to his will digs in submerged rocks vast chambers which he fills with explosives and displaces the very foundations of old ocean.

He is not content merely to discover steam and electricity and the other great forces of nature, but he harnesses them to his plows and wagons, and continues to invent machinery by means of which they may be still more useful to him.

By steam he moves the engines which his genius has invented, and thus transports himself across continents and seas. Electricity becomes his swift-flying messenger, bearing his commands with lightning speed over mountains or under oceans, and chaining it he compels it to be his midnight sun. He stores up electricity and transports it as his prisoner from place to place to do his bidding. He seals up the rays of

the sun and carries them into dark places, there to work as his assistant in artistic labors.

He has invented the microscope, by means of which he beholds in a drop of water an ocean swarming with life.

Studying plants, he has not only named and classified them, but can examine their minute construction, their tissues and cells, and, not content with this, has invented ways of dissolving and analyzing them, as to the ultimate substances of which they are composed. He has compelled Nature to divulge to him her laws concerning the elementary substances of the earth. Nor has this satisfied his ambition, for with his telescope he has dared to peep into the private chambers of far-off heavenly bodies, and with his spectroscope has required them to tell of what elementary substances they are composed.

Earth, air, fire, and water become his obedient vassals; or, if they rebel, their very stubbornness arouses his defiant will, and he never rests until they are subdued, and yield to his sway. Undismayed by horror of cold, hunger, or even death, he has visited the home of the North Wind, and recorded the laws of its nature, and is now able to tell "whence the wind cometh and whither it goeth," and gives forewarnings of the uprising, course, and speed of storms.

He has a method of communicating with his kind superior to that possessed by any other animal. He has invented a language which he teaches to his children, and has even taught a part of it to other animals. Not satisfied with a spoken language he

has invented the art of writing, so that his valuable thoughts might not perish with his removal from his earthly abode, but be preserved for the benefit of succeeding generations. But even this has not satisfied him, and he has invented the printing of books.

Turning his eyes upon himself, he studies his own frame and the powers which give him motion; looks into the construction of every tissue, and notes the relation of it to life and the changes through which it passes to decay; learns that the cells of the brain have a relation to the nerves, and distinguishes nerves from each other by the offices which they perform, and does not stop in his audacious career until he has located himself in his own brain.

His presumption leads him, successfully, still further, and he looks upon himself within his House Beautiful and sees his own functions. By comparison he estimates the relation of memory and thought, and recognizes the importance of will-power and the delights of the imagination.

Not content with naming the earth and all it contains, nor yet with weighing the planets and mapping out their courses through the heavens, nor yet with handling in his thought the mysteries of his own nature, he assumes to discuss the powers and attributes of the Great Final Cause, and to lift the veil from the unknowable. Marvellous and incomprehensible are the powers of this inhabitant of the House Beautiful,

THE MAN WONDERFUL.

SUGGESTIONS TO TEACHERS AND SCHOLARS.

STUDENTS who desire to fully understand the construction of the House Beautiful, and teachers who wish to teach successfully, would do well to give some attention to dissecting. The eye or heart of a sheep or calf will give a good idea of those organs.

From a cat the position of the internal organs *in situ* can be learned. The first lessons can be upon the Kitchen, Butler's Pantry, and Dining-room, and these being removed, the other organs can be studied. In dissecting the eye it can be opened with sharp-pointed scissors by cutting all the way around in the sclerotic, a little ways from the border of the cornea; the eye will thus be opened with the lens in place. Do this while holding the eye in a basin of water. Put a large pin through the lens and take it out. If fresh, it will be transparent; if not, it will look like an opal, and when a pencil of light falls on it, will call forth exclamations of wonder at its beauty. With equal care the other parts of the eye can be separated, and will be sure to be admired. With children, seeing is knowing, and it is seeing that awakens interest and compels attention.

A chicken can be used to demonstrate how birds grind their food without teeth, their gizzard being the mill which grinds and their crop a storehouse in which to keep their provision before grinding.

Feelings of repugnance at such work are soon forgotten in the unfolding of unknown and unsuspected beauties, and in admiration of the Divine wisdom which constructed each and every part and adapted them with infinite skill for their harmonious working.

AIDS TO TEACHERS AND SCHOLARS.

PART I.

QUESTIONS ON CHAPTER I.—PAGE 9.

1. In what kind of houses did men first live? 2. What are the "modern improvements"? 3. Who built the first House Beautiful? 4. Has the Architect improved upon the original plan? 5. Who owned the first House Beautiful? 6. What is this house? 7. Is it you? 8. Of what are our dwellings made? 9. What is chemistry? 10. What is an elementary substance? 11. Of how many elements is the earth composed? 12. What elements are used in the House Beautiful? Name them. 13. Where do we obtain them? 14. What is being sick? 15. Of what is every organ made? 16. What is protoplasm? 17. What becomes of these cells? 18. What is growth? 19. What should we study? 20. Why? 21. What is the effect of exercise? 22. Why do we get hungry?

QUESTIONS ON CHAPTER II.—PAGE 16.

1. What is the first thing in building a house? 2. What is the foundation of the House Beautiful? 3. When put together what called? 4. What different shapes have bones? 5. Of what two materials are they made? 6. How can you obtain the earthy material? 7. How can you obtain the animal matter? 8. Is there more animal or earthy matter in the bones of children? 9. What is it to ossify? 10. When are the bones strong? 11. What forms the earthy matter in bones? 12. Where do we obtain it? 13. Who repairs the House Beautiful? 14 Who selects food for the different tissues? 15. What is the periosteum? 16.

What does it do? 17. For what are the holes in bones? 18 What is the difference between a dead and a living bone? 19 What do we call the animal matter of bones? 20. How should a baby be lifted? Why? 21. Is there more animal or earthy matter in the bones of old people? 22. Why is it dangerous for old people to fall? 23. What is "rickets"? 24. What is the best bone-building food? 25. What does "bolting" do?

Questions on Chapter III.—Page 21.

1. What is the framework of our House Beautiful? 2. How do the walls of our house differ from bricks? 3. Why do they not wear out? 4. Do we ever know anything about it? 5. What are these walls called? How many muscles are there? 6. How is the framework held together? 7. How do these braces hold it? 8. What are joints? 9. How many kinds are mentioned? 10. What covers the end of a bone at a joint? Why? 11. How is the knee joint enclosed? How held? 12. What makes the joints move? 13. Of what is the largest part of our body made? 14. How are muscles made? 15. How does a muscle resemble thread? 16. What wraps each muscular fibre? 17. What is this blanket called? 18. What is this sheath called? 19. How are the fibres placed together? 20. Of what are fibres made? 21. What takes place in them? 22. What might these fibrillæ be called? 23. What is the sheath that encloses a muscle called? 24. What does it mean? 25. Where is fat always found? With what? 26. With what are muscles supplied? 27. By what are muscles attached to the bone? 28. What gives the body its shape? 29. What effect has use upon muscles? 30. How are they arranged on the trunk of the body? 31. Why is this arrangement good? 32. How can you make muscles stronger and thicker? 33. What is the result of overwork? 34. When are the walls repaired? 35. Why is it wise to build up strong walls? 36. What would we think of a house that needed external supports? 37. Does our house need external supports? 38 Whom should we trust?

Questions on Chapter IV.—Page 28.

1. What is a minister? What is a servant? 2. What depends upon the servants of the House Beautiful? 3. Under what two heads are they comprised? Name them. 4. Where do we find the voluntary muscles, and what is their use? 5. How do we resemble a snail? 6. How are joints formed? 7. What is upon the end of each bone? And what is it like? 8. How oiled? 9. What holds the bones in place? 10. What is mulishness in a boy called? 11. What is obstinacy in a grown person called? 12. What is perseverance in a ligament called? 13. Of what use is it? 14. If you feel up and down your back what will you find? 15. Of what is the spinal column made? 16. How are they fastened together? 17. What is between the rings of the backbone? 18. What happens when you lean forward? 19. What do the ligaments do when you straighten up? 20. What is the business of the ligaments? 21. What do they do when a bone is dislocated? 22. Do the bones help? 23. Do all the muscles help? 24. What does this teach us? 25. What is tonicity? 26. What is sensibility of a muscle? 27. What is contractility of a muscle? 28. How are the muscles that move the arm fastened? 29. What bends the elbow? What straightens it? 30. Why must we have two sets of servants or muscles? 31. What are the flexors? The extensors? 32. Do they ever interfere with each other? 33. Does a muscle change in size in contracting? 34. Where does the weight of the body rest when standing erect? 35. What muscles keep us erect? 36. How do we walk? 37. What protects us from jars? 38. Do the muscles assist us in sitting? 39. When do we rest best? 40. Of what servants have we been speaking? 41. Of what do the involuntary muscles take charge? 42. Why is standing more tiresome than walking? —Ans. Because in standing only one set of muscles is employed, while in walking there is a constant change from one set to another.

QUESTIONS ON CHAPTER V.—PAGE 38.

1. What is peculiar about our House Beautiful? 2. What kind of a covering should such a house have? 3. What is the siding? 4. How fastened?—ANS. To elastic tissue. 5. What is the sheathing of the house? 6. Of what is it made? 7. What causes "goose flesh"? 8. What is the second layer called? Describe it. 9. Where can you see these papillæ? 10. What is above the true skin? 11. What is in the lower layer? 12. What is the color of the true skin of a negro? 13. What is the outer layer of the epidermis called? 14. Of what is it made? 15. How many of these cells to the square inch?—ANS. A billion. 16. Of what use is the epidermis? 17. What makes callous places on the skin? 18. What is the function of an organ? —ANS. It is the office which it performs. The function of the stomach is digestion; of the liver, secretion of bile. 19. What are two functions of the skin? 20. What does the owner do if the house gets too hot? 21. How is the cooling process accomplished? 22. Describe the sweat glands. 23. How long a tube would these coils make? 24. How many to a square inch on the cheeks? Forehead? Palms? 25. What is passing out through them? 26. What is it called? 27. How much is thrown out in 24 hours? 28. Under severe exercise how much? 29. Why can men stay in a hot oven without harm? 30. What is the normal (natural) temperature of the body? 31. What is the effect of the solid part of the perspiration remaining on the skin? 32. What is the effect of stopping all the pores of the skin? 33. What is a third function of the skin?—ANS. It absorbs; medicines are sometimes administered through the skin by absorption. 34. What are the nails? 35. What about the layers? 36. What do they protect? 37. What is a thatch? 38. What can you tell about the roof of our House Beautiful? 39. How should we care for it? 40. What is at the root of each hair? 41. Who makes the best hair-oil? 42. Where else are these hairs? 43. What is the hair? 44. Of what does it consist? 45. Where do the roots of

the hair originate? 46. What and where is the mother of the hair? 47. Where is the coloring matter of the hair? 48. What is the form of the root of the hair? What empties there? 49. What are the oil-bottles called? And where found? 50. What is their use? 51. How many hairs on the head?

Questions on Chapter VI.—Page 45.

1. What is an observatory? 2. Who resides in the observatory of our house? 3. How many bones in the head? 4. What bone is movable? 5. Where is it joined to the other bones of the head? 6. How are the bones of the skull divided? 7. How many form the cranium? 8. Name the one at the back of the head. 9. Name the two at the sides. 10. What one makes the arches over the two windows? 11. What is on the outside of the skull? 12. Where are the windows? How many are there? 13. Upon what does the observatory rest? 14. What holds up the observatory? 15. What is the name of this bone? 16. How does it differ from other vertebræ? 17. How is the opening in it divided? 18. What passes behind this band? 19. What passes up before it? 20. What does this form? 21. What is this second vertebra called? 22. What rests upon the two depressions of the atlas? When? 23. What forms the neck? 24. What is their use? 25. What different motions has the head? 26. Why is there no need of a skylight? 27. How much will the cavity of the skull hold? 28. What does it contain? 29. What lines the bony cavity of the skull? 30. What does dura mater mean? 31. What membrane is inside of this? 32. What is inside of the arachnoid? What does it contain? 33. What does a French writer call the brain? 34. Describe the brain. 35. What are the depressions in the external surface of the brain called?—Ans. *Sulci.* 36. What do the number and depth of these sulci denote? 37. What two colors in the substance of the brain? 38. Which is on the inside? 39. Of what is the gray matter composed? 40. What does it generate? 41. Of what is the white

matter composed? What is its office? 42. Is the brain hard or soft? 43. What is the average weight of a brain? 44. How is the brain divided? 45. Where is the great brain? 46. Where is the small brain? 47. What connects the two? 48. What holds the brain-cells together? 49. What is a cluster of them called? 50. What forms a battery? 51. What does it produce? 52. Of what use is this battery?

Questions on Chapter VII.—Page 53.

1. How many front-doors has our House Beautiful? 2. What color are they? 3. What can they do? 4. What is mucous membrane? 5. Where is it found? 6. How many teeth have we? 7. What are the four in the centre called? 8. What are those next to the incisors? 9. Which are the bi-cuspids? Why so called? 10. Which are the molars? How many? 11. What do these different teeth do? 12. Why do babies have no teeth? 13. What assistants are there in the hall? Where located? 14. Where are the teeth before they appear to view? 15. How many first teeth are there? 16. When can babies begin to eat starchy foods? 17. Why not before? 18. How must starch be changed to be digested? 19. Who does this work? 20. Where are the second teeth while the first are in the mouth? 21. Which second teeth appear first? At what age? 22. Which next? At what age? 23. When do the second incisors appear? 24. The bi-cuspids? The canines? The second molars? The wisdom? 25. Will we have a third set of teeth? 26. Are the teeth bone? What are they? 27. How are they set in the gum? 28. What is the enamel? 29. What is inside of this? 30. What is in the cavity of the tooth? 31. Which is the crown of the tooth? Which the fang? The neck? 32. How should we care for the teeth?

Questions on Chapter VIII.—Page 59.

1. What is the *uvula?* What does it do? 0. What is the pharynx?—Ans. The back part of the throat. 2. What are the

kitchen stairs called? 3. What is the peculiarity of the *œsophagus?* 4. What is at the bottom of the *œsophagus?* 5. What is this door called?—ANS. The cardiac orifice. 6. What is the shape of the kitchen? What is its color? 7. What is peculiar about the walls? 8. What is this for? 9. What are in the walls? 10. What are these hollows?—ANS. They are glands. 11. What is their function?—ANS. The secretion of gastric juice. 12. What do we call gastric juice?—ANS. The cook. 13. What organ do we call the kitchen of our house?—ANS. The stomach. 14. How many walls has the stomach? 15. What power have they? 16. In which direction do the different walls contract? 17. What effect has this upon the food in the stomach? 18. How long is this motion continued? 19. What does gastric juice do? 20. What opening leads out of the stomach? 21. What is a sphincter muscle?—ANS. It is a circular muscle that closes an orifice, as the sphincter muscle of the mouth? 22. What is done with fluids taken into the stomach? 23. What is the effect if fluids are taken during digestion? 24. What if the fluids are cold? 25. What is the normal temperature of the stomach? 26. Why should we chew our food thoroughly? 27. Why should we not eat too much? 28. Why should we eat regularly? 29. Ought we to take fluids between meals? 30. Ought we to drink cold fluids during digestion? 31. Ought we to drink hot fluids during digestion?

QUESTIONS ON CHAPTER IX.—PAGE 65.

1. What is the door leading out of the stomach called? 2. What does it mean? 3. When is the food allowed to pass this guard? 4. If food is not digested what happens? 5. If it can not be digested what happens? 6. What effect may this have on the pylorus? 7. If dangerous substances are taken into the stomach what happens? 8. How long a time is employed in stomach digestion? 9. What is the duodenum?—ANS. It is the beginning of the small intestines. 10. Why is it so called? 11.

With what is the duodenum fitted up? 12. What is their function?—ANS. First, to present a larger surface for secretion second, to prevent the food passing along too fast; third, by thus preventing a too rapid passage of the food to assist in mixing it more thoroughly. 13. What assistants begin their work in this room? 14. What organ secretes pancreatic juice? 15. What organ secretes bile? 16. How do they reach the duodenum? 17. Are they alike in their functions? 18. What are the kinds of food we eat? Name them. 19. What does saliva digest? 20. What does gastric juice digest? 21. What does pancreatic juice digest? 22. What does bile digest? 23. What other work does he do? 24. What is biliousness? 25. Why do we need fat? 26. Why do we need less meat in summer than in winter?

QUESTIONS ON CHAPTER X.—PAGE 71.

1. How wide and long is the dining-room? 2. Where is it situated? How many walls? Describe them. 3. What are the first two-fifths of the dining-room called? 4. What are the other three-fifths called? 5. What is the dining-room? 6. What fluid is secreted by the small intestines? 7. What is its function? 8. What are found in the small intestines? 9. What are the functions of the villi? 10. What is the food in the small intestines called? 11. What do the villi do for us? 12. What do they do with what they eat? 13. Follow a mouthful of food through the process of digestion. 14. What moves the food through the intestines? 15. What is this motion called? 16. What may cause a pain in the bowels? 17. What do we find at the lower end of the small intestines? 18. Into what does it open? 19. What lines the walls of the colon? 20. Is all the food which we eat entirely used up? 21. What really nourishes us?

Questions on Chapter XI.—Page 79.

1. How many tenants has the House Beautiful? 2. What happens when the tenant moves out? 3. How can we tell whether the tenant has moved out? 4. What is peculiar about the House Beautiful? 5. In very new houses how does the engine work? 6. At one year old how many strokes will it make in a minute? 7. At three years old? 8. At thirty years? At eighty? 9. If the engine varies from this what do we know? 10. What is the engine? 11. Where does the heart lie? 12. What shape is the heart? 13. How is the heart divided first? 14. How is it then divided? 15. What are the upper divisions called? 16. What are the lower divisions called? 17. Which are the larger? —Ans. The ventricles. 18. What kind of blood is in the right side of the heart? 19. What kind in the left side? 20. What brings the blood from the upper part of the body to the heart? 21. What brings it from the lower part of the body? 22. Where does it empty?—Ans. Into the right auricle. 23. What sends the blood into the right ventricle? 24. What is there between the auricle and ventricle? 25. Why can not the valves swing back into the auricle? 26. Where does the blood go from the right ventricle? 27. What valves are here? 28. What brings the blood to the left auricle? From where? 29. Where does the blood go from the left auricle? 30. Where from the left ventricle? 31. Where from the aorta? 32. Where are the bi-cuspid valves? 33. Where are the tri-cuspid valves? 34. What other name have the bi-cuspid valves? Why? 35. Which side of the heart has the thicker walls? Why? 36. How much will each ventricle hold? 37. How often does a man's heart beat in a minute? 38. How often in an hour? 39. How many strokes will that make in an hour? 40. How many strokes in a day? 41. How many ounces will the heart raise in a day? How many tons? 42. When does the heart rest? 43. When does it rest most? 44. What is the effect of over-exertion upon the heart?

Questions on Chapter XII.—Page 87.

1. What is the duty of a housekeeper? 2. Who does the repairing? 3. Who selects the material? 4. And gives it to whom? 5. Who is the housekeeper of our house? Starts from where? 6. What makes the color of her dress? 7. With what are the red corpuscles loaded and what do they do? 8. What is the shape of these corpuscles? 9. How many of them in an inch side by side? 10. What else does the blood carry? 11. What size, and how many? 12. In what do these corpuscles float? 13. Through what hall does the housekeeper go? 14. What force hurries her along and through what doors? 15. Where does she go through the halls? 16. Describe these halls, their name. 17. How can you feel the blood passing through the arteries? 18. When the halls are very narrow what are they called? 19. How does blood change her dress in the capillaries? 20. What does she carry back toward the heart? 21. How does she leave the capillaries? 22. How does she reach the heart from the feet? 23. How from the upper part of the body? 24. How do the veins differ from the arteries? 25. Do they communicate with each other? 26. What veins are provided with valves? 27. What does holding your hand above your head prove? 28. How does the blood flow through veins? Through arteries? 29. How is knowledge of this fact useful? 30. What is the difference between cutting an artery and a vein? 31. How much more blood do the capillaries contain than the arteries? 32. What portion of the body—in weight—is blood? 33. How long is the blood in passing through the heart? 34. Where does the blood travel faster—in arteries or veins? 35. How many inches in a second near the heart? 36. At the foot how many? 37. How do the corpuscles move in the capillaries? 38. Do they crowd each other? 39. Where do capillaries exist? 40. What is blushing? 41. What is finer than a needle-point? 42. What will the housekeeper do if the door is opened? 43. Who stops bleeding when it occurs? 44. What does she

carry with her? Who tangles around her feet? 45. What is this tangling called? How does it act? 46. What stops the bleeding? 47. Where does nutrition take place? 48. How? 49. What does a nerve say? 50. What does a bone say? 51. A muscle? 52. What does a hair say? 53. What does each one get? 54. What if each does not get what he desires? 55. Who has provided everything needful? 56. Where do we obtain food?

Questions on Chapter XIII.—Page 95.

1. Who is our washerwoman? 2. Where does she enter? 3. What if she is cold? 4. What occurs to foreigners? 5. Where does she now enter? 6. Through what stairway does she go? Its name? 7. What keeps it open? How many? 8. Where does the trachea divide? 9. Where do they lead? 10. What are they called? 11. In what do they terminate? 12. How large are these tubs? 13. How many tubs or air-cells in the lungs? 14. How thick are the walls of these air-cells? 15. How large a surface would they cover? 16. How does the blood reach the lungs? 17. How small are the smallest capillary tubes? 18. What do they resemble? 19. What are they called? 20. What do they encircle? 21. With what are they filled? 22. Of what does the laundry consist? 23. What is remarkable about these rooms? 24. What is the floor of the thorax called? Its shape? 25. How does this change the cavity of the thorax? 26. What are the bony walls of the thorax? 27. With what covered? How do they act? 28. How do we breathe the air out? 29. What is breathing in called? Breathing out? 30. Both together? What is expiration? 31. What do physiologists say? 32. Why are the two types of breathing so called? 33. What is my secret? 34. Which type of breathing is artificial?—Ans The thoracic. 35. Who know how to breathe? 36. Why did Aura enter the house with alacrity? 37. What is she always trying to do? 38. What is Aura's washing fluid? 39. What does she receive from the blood? 40. What does she give to the blood?

41 What effect does this have on the blood? 42. What effect on Aura? 43. What would happen if you invited her back at once? 44. Where should she shake her garments? What happens? 45. What is osmosis? 46. Describe washing the blood. 47. How often does Aura go in and out? 48. Why do we breathe? 49. What is the most important food of the body? Why? 50. Why must the supply be constant? 51. Where do we get hungry? 52. Where do we get thirsty? 53. What is sighing? Yawning? 54. Are the lungs filled and emptied at every breath? 55. What is a cube? 56. How much does a pint cup hold? 57. How much goes in and out with every breath? 58. What is this called? 59. What is complemental air? 60. What is reserve air? 61. What is residual air? 62. What is vital capacity? 63. What peculiarity of the Gas family is mentioned? 64. What is this called? 65. What are the cilia? 66. What do they do? 67. What ought we to think about breathing? 68. What is our best food? 69. What poison does Aura sometimes take with her? 70. Have we a right to pure air? 71. By what door should Aura enter and depart? 72. What is snoring? 73. What doors should you shut on going to sleep? 74. Why should you shut the mouth? 75. When should you shut your mouth and open your eyes?

Questions on Chapter XIV.—Page 107.

1. Where is the furnace located? 2. What is the furnace? 3. What are glands? 4. What does the liver manufacture? How do we know? 5. How can we prove that there is a fire? 6. How much does the liver weigh? 7. How large is it? 8. Where does it lie? 9. What effect has a tight dress? 10. How does it complain? 11. What does being bilious mean? 12. How is the liver divided? 13. What is in a niche in the right lobe? 14. How much does it hold? With what filled? Its name? 15. What makes the quartette of quintettes? 16. What does the portal vein say? 17. What is the portal system? 18.

What are lobules? 19. What between the lobules? 20. What artery brings blood to the liver? 21. What does the hepatic duct do? 22. How much bile made each day? 23. How is the bile used? 24. Where is the bile probably made? 25. Where is the sugar made? 26. What is stranger than a fairy tale? 27. Out of what do they make the sugar? 28. How is sugar used in the body? 29. Why should we not eat too much candy? 30. What is the normal temperature of our house? 31. Are we as warm as we suppose when we run? 32. What is a second way in which our house is heated? 33. What is oxidation? 34. What is the third way of warming our house? 35. What do the lungs do to the cold air? 36. What three modes then of heating the house? 37. How much does sawing wood raise the temperature of the biceps muscle?

Questions on Chapter XV.—Page 115.

1. What is secretion? 2. What is excretion? 3. Why are the mysterious chambers not excretory organs? 4. What are they? 5. Why are they not for secretion? 6. Where is the thyroid gland? 7. Where is the thymus gland? 8. What can you tell about them? 9. Where are the pituitary body and pineal gland? 10. Who find out about their use? 11. Where are the supra-renal capsules? 12. What did Addison think they were for? 13. Where are the tonsils? They are a pair of mysterious chambers in the hall or mouth, just in front of the pink curtain. 14. What can you say about them? 15. What is the last mysterious chamber, and where located? 16. How large is it? 17. What is the spleen? 18. What have physiologists noticed? 19. Of what do they feel sure?

Questions on Chapter XVI.—Page 122.

1. Where is the central office in our telegraph system? Name it. 2. How many cells are employed by the Western Union Tele-

graph Company? How many in our system? 3. What do we call our electricity? 4. What do we call our telegraph wires? 5. How many pairs of nerve-cables go out from the central office? 6. What is a nerve-cable?—ANS. A great number of nerves going out in a bundle enclosed in one sheath. 7. Where are our branch offices located? 8. How many of them are there? 9. How are the vertebræ put together? 10. What passes down through these holes? 11. Of what is the spinal cord made? 12. Where are the gray cells in the brain? 13. Where are they in the spinal cord? 14. By what are they surrounded? 15. What does this white material form? 16. From what points do they issue? 17. Where are these white threads distributed? 18. What is a ganglion? 19. What may it be considered? 20. What is the cerebro-spinal nervous system? 21. What is the meaning of insulated?—ANS. When a wire is wrapped in such a way that the electricity can not pass from that wire to another it is called insulated. 22. What is the sheath of the nerve-cable called? 23. Describe a nerve. 24. What is the axis cylinder of a nerve? 25. What is communicated through it? 26. How do nerve-fibres terminate? 27. Do nerve-cables interchange fibres? 28. Do the fibres lose their identity? 29. How many kinds of nerve-fibres? 30. What is the duty of a nerve of sensation? 31. What is the duty of a nerve of motion? 32. Do they ever exchange works? 33. Do they communicate with each other? 34. Where do they go to give their information? 35. What are the nerve-cables that pass out from the front of the spinal cord? 36. What from the back part of the cord?

QUESTIONS ON CHAPTER XVII.—PAGE 129.

1. What is a phonograph? 2. Have we anything like it in our House Beautiful? 3. What does it repeat? 4. What is it called? 5. What do we find on the sensory nerves of the cerebro-spinal system? 6. What are these ganglia? 7. Where does the other division begin? 8. How many of these ganglia? 9. Where do

they pass? 10. How are they intimately connected with the cerebro-spinal system? 11. What do we find in every part of the body? 12. What do the fibres of the sympathetic system form? 13. Where are they found? 14. What is a plexus? 15. Where does the cerebro-spinal system carry messages? 16. From whom does the sympathetic system receive its orders? 17. What govern all bodily processes which are not under control of the will? 18. Give an illustration. 19. How can we govern the action of the lungs? 20. What can you say of swallowing? 21. What two nervous systems govern the act of swallowing? 22. Is digestion voluntary? 23. Describe digestion. 24. What orders are given when food enters the duodenum? 25. What takes place in the small intestines? 26. Into what glands does the food pass? 27. Through what duct? 28. Into what vein? 29. Where? 30. What is done with that which is not nourishing? 31. What are the strainers? 32. What do they separate from the blood?

Questions on Chapter XVIII.—Page 134.

1. What safeguard has our House? 2. What have you learned in regard to the Observatory? 3. What in regard to the Telegraph? 4. For what purpose are some of these wires and batteries used? 5. To what part of the House do they go? 6. What nerves are we speaking of and where do they arise? 7. What is said of Pain? 8. What in regard to his warnings? 9. Where do the Nerves of Sensation end? 10. Where are they most abundant? 11. What can we see at the ends of our fingers? 12. Where are the tactile corpuscles in greatest numbers? 13. What proportion of them on the ends of the fingers? 14. What on the second joint? 15. What is the forearm? 16. Why should we expect that the forearm would not be very sensitive? 17. Why are some parts of the body more sensitive than others?—Ans. Because they are supplied with a greater proportion of tactile corpuscles in the papillæ. 18. What sensations have we besides pain? 19. What illustration of how the sense of touch can be educated?

QUESTIONS ON CHAPTER XIX.—PAGE 137.

1. How many senses have you been told that you have? 2. How many have you? 3. What can you tell of yourself with your eyes shut? 4. In lifting a pail of water, of what do you think? 5. Do you have to try twice in order to know how much strength to use to lift it? 6. How do you know just how much strength to use? 7. What do we call this sixth sense? 8. What do you learn by muscular sense? 9. How acute does this sense become by cultivation? Illustrate. 10. In walking what does muscular sense tell us? 11. How does the loss of this sense in the legs and back affect one? 12. Can one sense assist another? 13. What sense assists muscular sense? 14. What is necessary when muscular sense is lost? 15. Illustrate. 16. Can muscular sense supply loss of sight? Illustrate. 17. Who have muscular sense well developed? 18. Can you illustrate this by an incident of a great fire in New York?

QUESTIONS ON CHAPTER XX.—PAGE 141.

1. What is the finest musical instrument? 2. What is in the throat? 3. Describe the larynx. 4. What is the *epi-glottis?* 5. When is it open? 6. When closed? 7. What do we find near its top? 8. How are they situated? What named? 9. How can you illustrate the larynx? 10. Try it. What do your thumbs represent? 11. What does the opening between your thumbs represent? 12. What is the movement when we breathe? 13. What is it to vibrate? 14. If sufficiently rapid what will it produce? 15. What kind of a tone does a long string produce? A short one? 16. How many vocal chords are there? 17. What do the nine little muscles do? 18. What is the effect of tightening the chords? 19. What causes the tone in the flute? 20. With what does the pitch of a note vary? 21. How is the human voice produced? 22. In low sounds how is the column of air affected? In high sounds? 23. What is the reed of a melodeon? 24. What effect has shortening the chords? 25.

What causes the chords to vibrate? What acts as the sounding-board of the human organ? 26. What effect has a sounding-board? 27. What are the bellows of the voice? 28. What pumps these bellows? 29. What difference is there in voices? 30. What makes the bass voice? 31. What the baritone or tenor? 32. What the contralto or soprano? 33. What is said of our simple instrument? 34. What is the range of the human voice? 35. What is the average compass? 36. What is timbre in a voice? 37. Upon what does it depend? 38. Can the timbre of the voice be changed by proper instruction? 39. Upon what does the strength of the voice depend? 40. How is the voice like a violin? 41. Why is it like a piano? 42. Why like a flute? 43. Why more like an organ?

Questions on Chapter XXI.—Page 148.

1. What is the pinna? 2. How is it attached to the head? 3. How many muscles has each ear? 4. What are they called? 5. Try and move your ears. 6. What is in the centre of the pinna? 7. What guards are stationed at the entrance to the ear?—Ans. Hairs and ear-wax. 8. Where does the doorway lead? 9. What is the name of the bone through which the channel is tunneled? 10. How is it lined? What is it called? 11. What directions does this channel take? 12. Does it get larger? 13. How long is this canal? 14. How is it closed? 15. Is it a movable curtain? 16. How can we get on the other side of the curtain? 17. What passage leads from the throat to the ear? 18. How long is it? 19. What is the auditorium? 20. Where is it? 21. What is this curtain called? 22. Which way does the top lean? 23. What is the furniture of the middle ear. 24. Upon what does the head of the hammer play? 25. To what is the handle attached? 26. What other furniture is there in the middle ear? 27. For what is the stirrup used? 28. What is this window called? 29. Of what material is this furniture made? 30. How arranged? 31. What is necessary? 32. How

many muscles are needed for this purpose? 33. How are they attached? 34. What is the effect of their action? 35. Through what does an air-wave communicate? 36. What fills the middle ear? 37. How does it communicate with the outer air? 38. How can pain in the ear sometimes be relieved?

Questions on Chapter XXII.—Page 155.

1. Where is our whispering gallery? 2. From what point do we start to visit this gallery? 3. What do we find there? 4. What do they form? 5. What nerve does it touch in passing out? 6. Where does it hide itself? 7. Where does it divide? 8. Where does one portion go? 9. What kind of waves do we hear? 10. Through what do they pass? 11. Name the three bones. 12. What closes the oval window? 13. What is beyond this oval window? 14. What is the first division of the whispering gallery? 15. How have we already reached this same place? 16. To what is the vestibule an entrance? 17. What is the meaning of labyrinth? 18. What do we find in the vestibule? 19. What are the name and shape of the first? 20. What of the second? 21. What do they contain? 22. What are their names? 23. In what animals are they found? 24. What open out of the vestibule? 25. Where do they lead? 26. By what is it surrounded? 27. How many of these passageways are there? 28. What do they contain? 29. What is their shape? 30. If we enter one where will we come out? 31. Where is the branch of the nerve going to the vestibule distributed? 32. Where do some think the nerves terminate? 33. Can we hear without the otoliths? 34. What begin in the vestibule? 35. How often do they wind around? 36. What is the top like? 37. What is the cochlea? 38. What is said of the wall between these stairways? 39. What is in this hollow? 40. What fills this stairway? 41. What do we find climbing this stairway? 42. How are they standing? 43. What do they form? 44. How many of them? 45. How many of the little clubs make

an inch in length? 46. Where do we find the shortest? 47. Where the longest? 48. What are they called? Why? 49. What are they altogether called? 50. Where does the second branch of this nerve go? 51. What do they pass through next? 52. Where is it believed that they terminate? 53. Does the air make waves? 54. Are they of different sizes? 55. How do they affect the drum of the ear? 56. What is noise? 57. What are strokes? 58. What is a buzz or humming? 59. What are musical tones? 60. What are tones of influence?—ANS. When the vibrations of one tuning-fork are communicated through the air to a second fork of the same pitch the tones produced by the second fork are called tones of influence. 61. How are the pillars of Corti acted upon? 62. What do they whisper to us? 63. What is the range of vibrations heard by the ear? 64. What is the compass of the best ear? 65. What is the compass of an ordinary ear? 66. Who could not hear the chirp of the common sparrow? 67. What produces waves of water? 68. What waves do the most harm? 69. How does the agitation of the ocean affect it? 70. What improves the air in cities?

QUESTIONS ON CHAPTER XXIII.—PAGE 165.

1. How many windows in our House Beautiful? 2. Where located? 3. What separates them? 4. What protects them below? 5. What is the hollow within these bones called? 6. What nearly fills it? 7. What is behind the eyeball? 8. What does it do? 9. Why are the eyes so protected? 10. What is there over each? 11. When does it come down? 12. How is it trimmed along the edge? 13. Is this fringe all for looks? 14. How does it protect? 15. What moves these awnings? 16. When do they work, and how? 17. What do they do when you are asleep? 18. What is the name of these awnings? 19. What is the shape of the windows? 20. Are they like a sphere? 21. Which diameter is the greater? 22. What is the outside covering of the eyeball called? 23. What proportion of the eye-

ball does it cover? 24. What is it generally called? 25. Why is it opaque? 26. What covers the other sixth of the eyeball? 27. How thick is it? 28. How strong is it? 29. What does transparent mean? 30. Where are the curtains? 31. What are they like? 32. How many of them? 33. What are they called? 34. What form the first coat of the eye? 35. What the second coat? 36. What is its color? 37. What part of the eyeball does it cover? 38. What does it leave in front? 39. What covers this on the outside? 40. How are the edges of this circular opening arranged? 41. What are they called? 42. What laps on over these? 43. What is the ciliary muscle? 44. What is its function? 45. What is the Latin name of the portière in the window? 46. What does it mean? 47. What has the iris in the centre? 48. How large is this opening? 49. How large is the curtain? 50. What color? 51. With what does its color generally harmonize? 52. What is the opening in the iris called? 53. What closes the pupil? 54. Who manages these curtains? 55. What is the third coat called? 56. Where is it located?—ANS. Inside of the choroid coat. 57. What is inside of this coat? 58. What kind of a body is it? 59. What shape is it? 60. How is it in front? 61. Where is this hollow? 62. What is in this hollow? 63. What is the shape of a convex lens? 64. What is the shape of this crystalline lens? 65. Where is it placed? 66. What passes through it? 67. What holds it in place? 68. What kind of a membrane is it? 69. What completes the choroid coat? 70. What hangs in front of the lens? 71. How does the iris divide the eye? 72. What are these two chambers called? 73. Who washes these windows? 74. Where is the lachrymal gland? 75. What does it do? 76. What secretes the tears? 77. How many ducts has it? 78. Where does this watery fluid collect? 79. Where is it used? For what? 80. What is winking? What prevents friction? 81. Where does this fluid go after it has washed the eye? 82. What opening along the lower lids? 83. What do they furnish? 84. What does it do? 85. What is the effect if the tears run over the cheeks? 86. What effect has sorrow? 87. What animal can weep over the sorrows of others?

Questions on Chapter XXIV.—Page 175.

1. Who sits in darkness and silence? 2. When does he leave the House Beautiful? 3. How does he learn of the outer world? 4. What originate among the nerve-cells? 5. What do they constitute? 6. How does the man become acquainted with himself? 7. How does he become acquainted with the "Not me"? 8. What indicates the importance of the double telescope? 9. What is a telescope? 10. What are used to change their position? 11. What kind of telescopes has the Man Wonderful? 12. What is the common name for them? 13. How many muscles are there to move each eye? 14. What is said of the superior oblique muscle? 15. What cause the eyeball to rotate? 16. Which is the most important nerve that goes to the eye? 17. Where does it have its origin? 18. What form the optic commissure? 19. What is the arrangement of nerve-fibres in the optic commissure first? Second? Third? Fourth? 20. Where do these fibres enter? 21. With what do they connect? 22. Give a review of these nerve-fibres. 23. What arrangement would connect the eyes more intimately? 24. What is said of the point where the optic nerve enters the eye? 25. What is the relation of the optic nerve and the central axis of the eye? 26. What is there at the central axis of the eye? 27. What is its horizontal diameter? Its vertical diameter? 28. What is it called? 29. What is in the centre of it? Its name? What light falls upon the fovea centralis? 30. What does the optic nerve form? 31. What is its thickness at the yellow spot? 32. Does it get thicker? 33. What rests upon this? 34. How many layers of cells at the yellow spot? 35. What kind of cells? 36. What does each one do? 37. Are filaments sent in the other direction? 38. With what do these latter filaments connect? 39. Where are the rods and cones? 40. What are they? 41. Where does the light strike? 42. To what is the impression transmitted? 43. What happens if the light does not strike the centre of the yellow spot? 44. What must be done to effect this change? 45. Through what transmitted? What nerves? 46. To what? 47. When too much light enters

the eyes what happens? 48. When the object is too near? 49. What makes the lens more convex? 50. Are such messages sent often? 51. When the eyes do not act together what do we call it?—ANS. Cross-eyed. 52. What enters with the optic nerve? 53. What does it do? 54. What is the effect of the reflected light? 55. What is the effect of light passing through the air? 56. What does the analysis of light show? 57. What is a radiometer? 58. Of what is light compounded? 59. What determines the color of light? 60. What is the length of a wave of red light? 61. At what rate does light travel?

QUESTIONS ON CHAPTER XXV.—PAGE 184.

1. Where will we find one guardian of our house? 2. What is his appearance and nature? 3. Does he ever go out of the house? 4. Is he bashful about expressing his opinion of visitors? 5. What is said of his friendships? 6. What is said of material for repairs? 7. Who examines it? 8. Is his decision final? 9. What does he say? 10. What is his name? 11. By what name generally known? 12. Can he always be trusted? 13. Of what is he very fond? 14. What effect has this upon the assistants in the kitchen? 15. Where do they send it? 16. Is this agreeable to taste? 17. If the servants are not strong enough to send out the offending material, what happens? 18. What does the doctor do? 19. What is the result? 20. Will taste avoid the disturbing substance after this? 21. What is therefore important? 22. Who can discharge him? 23. What must we then do? 24. What will he then do? 25. Who should be master of the house? 26. When can taste be trusted? 27. What will he like? 28. How does he lose his ability to judge correctly? 29. Why should we give him a good education? 30. What does the taste of children sometimes demand? 31. What do papas or mammas sometimes do? 32. What is the effect? 33. What effect has it to deprive him of company? 34. What bad habits may he acquire? 35. How does it affect the cooks? Why? 36. When

reason does not govern taste, what happens? 37. What is the effect of eating too much? 38. What is another bad habit? 39. What does this cause? 40. What is the effect of indigestion? 41. Is the house well repaired? 42. What is the advantage of eating slowly? 43. What is a third bad habit? 44. What food is good?

Questions on Chapter XXVI.—Page 191.

1. Where does another guardian make his home? 2. Who discovered his hiding-place? 3. Where is it? 4. Who presides over foods and drinks? 5. Whom can not he examine? 6. Who assists him? 7. What is said of Aura? 8. To whom is she related? 9. What enemy to life is spoken of? 10. What does smell detect? 11. How does Aura act? 12. If there is bad air in a cellar what will you do? 13. What will Aura do? 14. When does smell fail to do his duty? 15. At this time can we tell the true taste of food? 16. When has smell lost his conscience? 17. What is the effect of sleeping with closed windows? 18. What opinion does smell express? 19. What causes the bad odor? 20. Illustrate the uncleanliness of bad air. 21. Is it necessary to have a draft in a sleeping-room? 22. How can we catch the gases that are lighter than air? 23. What gas is being thrown off from the lungs? 24. What is said of this gas? 25. What effect has it upon a lighted taper? 26. If we leave a cup full what happens? 27. How do we become acquainted with the smell of a substance? 28. What is said of a grain of musk? 29. What of contagious diseases? 30. What of disinfectants? 31. What is the perfect disinfectant?

Questions on Chapter XXVII.—Page 196.

1. What is the façade of a house? 2. Why so called? 3. How may it be ornamented? 4. What makes an object beautiful? 5. What is said of symmetry? 6. What is said of the

useful? 7. What is said of our foundations? 8. What of the muscles? 9. What beauty can not be expressed by a statue 10. From what does the beauty of the human form arise? 11. Describe a world of chance. 12. Why should we not find fault with our bodies? 13. Does the shepherd need the strength of a warrior? Why? 14. What do the proportions of man signify? Those of woman? 15. What do we look for in boyhood? In manhood? 16. Where do we look for strength in the wrestler? In the racer? 17. Will fitness alone constitute beauty? 18. What else is needed? 19. How can we judge of the Man Wonderful? 20. What can we tell about him? 21. What does the form of the babe indicate? Of the youth? Of the man? 22. What is unity of design? 23. What part of the body is the most expressive? 24. From what do we judge of character? 25. How do we sometimes speak of lifeless things? 26. What gives expression to the face? 27. What can you do with your face to affect your feelings? 28. What does attitude of the body express? 29. What two ways have we of expressing feeling? 30. What is said of ancient statues? 31. What aids the public speaker? 32. What adds beauty to the façade? 33. When will the expression be the same? 34. What changes the expression of the face? 35. What is said of anger? 36. What most reveals the feelings? 37. What do we see when the man looks out of the windows? 38. What unspoken language expresses character? 39. Is the same gesture always appropriate? 40. What is said of the coloring of the house? 41. What causes the color of the face to change? 42. How may anger affect the face? 43. What should color be? 44. What does Ruskin say of color? 45. What makes the best complexion? 46. What is better than regular features? 47. Where then does our beauty lie? 48. What will awaken admiration and awe? 49. How does the House Beautiful differ from these cathedrals? 50. Who aids us to remould our features?

PART II.

QUESTIONS ON CHAPTER I.—PAGE 205.

1. What is now the condition of the House Beautiful? 2 What have we admired? 3. What is peculiar about the house? 4. Is the house to be inhabited? 5. What is peculiar about the tenant? 6. What will you learn about him without seeing him? 7. Who is this tenant? 8. What is he? 9. To what is he a stranger? 10. Why is the house not complete? 11. Who are untrained? 12. Of what is the Master incapable? 13. Does he look out of the windows? 14. What appears to be in working order? Why? 15. What is said of the human baby? 16. What of calves, colts, etc.? 17. What will the baby do if left alone? 18. Why? 19. To what is he superior, and why? 20. Of what are they a prophecy? 21. What was the design of the Architect? 22. When is the house sometimes vacated? 23. What apology can be made for this? 24. What advantage has man over brutes? 25. What could he prevent? 26. What does a baby need first? 27. Where can we find a model garment? Why? 28. What should be avoided in a baby's dress? 29. How happy will a baby be? 30. If it is unhappy what is the reason? 31. What is personal magnetism? 32. Who feels this? How do we know this? 33. What is said of the child's electrical condition? 34. What does this explain? 35. What is the next need of a child? 36. What is said of regular habits? 37. What takes place in sleep? 38. What should you not do? 39. What will you do to secure quiet sleep for a child? 40. What now happens? 41. What is the inhabitant of the house beginning to do? 42. Of what is he unconscious? 43. How are his voluntary movements made? 44. Why does he keep in motion? 45. What is the baby's business? 46. What ought he to have? 47. What will he first learn? 48. Then what? 49. What is there in this wriggling thing? 50. To what

does it impel the child? 51. Then what happens? 52. What is said of walking? 53. What is walking called? 54. Why is running more difficult than walking? 55. What is remarkable about the first five years of life? 56. What teaches the child? 57. What does the rattle teach? 58. The doll? The baby-jumper? The rocking-horse? 59. The swing? The skipping-rope? Rolling the hoop? 60. Playing marbles and ball-playing? 61. What does repeating a task do? 62. What is the child becoming? 63. What is said of calisthenics?

Questions on Chapter II.—Page 212.

1. What does the Man Wonderful include? 2. What is the girl? 3. What is said of her house? 4. How will she get a strong body? 5. What girl has not been well educated? 6. In what are girls like boys? 7. Upon what do girls pride themselves? 8. Upon what do boys pride themselves? 9. What hands are the most beautiful? 10. In what is the greater part of life to be spent? 11. What can be taught little people? 12. How can the mother amuse the child? 13. What will careful training do? 14. What is more attractive than playing keep house? 15. What can a girl of eight years do? 16. What should a girl of fourteen be able to do? 17. What time is sufficient to learn this? 18. Who has found skilled hands of use? 19. What is worth more than money? 20. What have girls got? For what? 21. What may boys and girls find of value to them? 22. What is said of boys and girls? 23. Who gave this impulse for activity? 24. What should take the place of "it is not lady-like"? 25. What should girls think of? 26. For what should she plan? 27. What is fortunate for a girl? 28. What employments are open to women? 29. What does a knowledge of practical work do? 30. Which is better, to know how to make bread, or play the piano? 31. For what should she have an ambition? 32. What says Solomon? Proverbs?

Questions on Chapter III.—Page 219.

1. In what is there pleasure? 2. Should this desire be cultivated? 3. What must the majority of people do all their lives? 4. What would be a valuable addition to our schools? 5. Where have such schools been tried? 6. How could they be arranged? 7. What advantage to a boy would these schools be? 8. What would he learn? 9. What is he thus becoming? 10. What effect would these schools have upon laws? 11. Upon the time spent in school? 12. Why might girls learn the use of tools? 13. Or boys cooking? 14. What is true education? 15. What does it develop? 16. What did the ancient Greeks believe? 17. What is the effect of cultivating the mind and not the body? 18. Of cultivating the body and not the mind? 19. What is said of college students? 20. Of what use is a symmetrical body? 21. Of what do young men too often think? 22. What is the golden mean in education? 23. What is the result of separating physical and mental education? 24. Why is there now no need of extreme development of body? 25. How may the body be injured? 26. What organ suffers in a rowing contest? 27. Why? 28. What is the effect of the exercise on the heart? 29. Is this a continued growth? 30. What then begins? 31. What does the heart become? The person? 32. Will he be conscious of this? 33. What may be the final result? 34. What is said of military drill? 35. What muscles are brought into play? 36. What valuable mental result? 37. What mischievous result avoided? 38. What need may arise in actual life? 39. What will be for the security of the country?

Questions on Chapter V.—Page 242.

1. What foreigner was brought to England and France two hundred years ago? 2. What is he familiarly called? 3. What do his friends say of him? 4. What is checking waste? 5. What is the testimony of science? 6. What is the chief action of coffee? 7. What does it do? 8. Why is it not desirable to

forget that we are tired? 9. What does Dr. Bartholow say of coffee? 10. What does Dr. Emmet say? 11. What effort does he think should be made, and why? 12. What do some people think? 13. What does Dr. Bartholow say of this? 14. What does that mean? 15. What question can we ask ourselves? 16. How can we be without coffee? 17. Who is the other foreigner? 18. What is his name? What usually called? 19. What is his complexion? 20. What are the properties of tea? 21. Which is the more stimulating? 22. What effect has the tannic acid of tea? 23. Why is that undesirable?—ANS. Because albumen is an important food, and when coagulated can not be absorbed, and therefore can not nourish the body. 24. What effect has long cooking of tea? 25. What is the result of living on bread and tea alone? 26. How can disorders caused by tea be cured? 27. What is a good rule? 28. Why is water a better drink than tea? 29. How much of the body is water? 30. What good do tea and coffee do? 31. Who can not drink tea and coffee? 32. What other doubtful visitors are mentioned? 33. What do they irritate? 34. What is the effect of pepper and mustard on the epidermis? 35. What effect on mucous membrane? 36. What do they beget? 37. What would you say of such articles?

QUESTIONS ON CHAPTER VI.—PAGE 250.

1. What twin-brothers guard our house? 2. What is their character? 3. What is said of the dislikes of taste? 4. What if the master becomes attached to bad friends? 5. To whom must we appeal, and for what? 6. How must we educate the master? 7. Who is the first bad guest mentioned? 8. Who met him, and when? 9. Who met him in 1519, and where? 10. When was he indispensable to the Indians? 11. When introduced to Europe, and how received? 12. To what queen was he presented? 13. Who has the credit of introducing him to England? 14. Who discovered him to be a dangerous friend? 15. Who issued a bull against him? 16. Where was he prohibited?

17. Who made laws against him? 18. What was written about him? 19. What did Charles Lamb say? 20. To whom does his beauty and sweetness introduce him? 21. What is said of his family? 22. Mention some of his kindred. 23. What are his name and personal appearance? 24. What is his conduct at a first call? 25. What is sometimes emptied by this uproar? 26. What may be suspended? 27. What is the effect of admitting him frequently? 28. Who are engaged in throwing him out? 29. How do we know this? 30. Who assist the lungs in getting rid of him? 31. He is a foe like what acid? 32. What is this poison called? 33. How much will it take to kill a rabbit in four minutes? 34. Whom would it kill in five minutes? 35. Who masquerades under different forms? 36. What character does he play most universally? 37. What does he tell the farmer or cow-boy? 38. What does he do while thus talking? 39. For what does he take great credit? 40. How did he appear among the Indians? 41. What is said of the pipe? 42. Does he ever put on more style? Where? 43. Where is he equally at home? 44. Where does he exert the same baneful influence? 45. What does he do to the tongue? 46. What to the red corpuscles? 47. To the cook? 48. To the salivary glands? 49. What has been traced to the use of the pipe? 50. How was he carried by his friends? 51. What was his character then and his claims? 52. Of what were snuff-boxes made? 53. What was an annual expense of the United States Senate? 54. Who had charge of the Government snuff-box? 55. What is the effect of snuff-taking? 56. Who suffers next? 57. Where does snuff collect? 58. What is said of the snuff-taker?

QUESTIONS ON CHAPTER VII.—PAGE 257.

1. What does he sometimes style himself? And takes what profession? 2. What does he claim to preserve? And what cure? 3. How do women use tobacco? 4. When is he most disgusting? 5. What people employ him as dentist? How?

6. What does he do to the teeth and gums? 7. What other guests does he introduce into the house? 8. How does he treat the cook and the glands? 9. How does he affect the master of the house? 10. What does he claim to do for all? 11. What sign does he put up where he is used? 12. How can you read this sign? 13. For what have Americans a world-wide reputation? 14. What measure of public safety is necessary? 15. What assists in legislation? 16. What sometimes adorns homes and pulpits? 17. In what case only is tobacco useful? 18. What next does he claim to be? 19. As medical assistant what diseases does he claim to cure? 20. How does he cure disease? 21. What effect does he have on the vigor of the country? 22. Mention some of the diseases he creates. 23. What does Dr. Richardson say? 24. What leads to strong drinks? 25. How does it affect the heart power? 26. What effect does it have upon the eye? 27. What can the French professor do? 28. What other sense does tobacco affect? How? 29. How does it affect the nerves? What nerves? 30. How does it affect the glands? 31. Whose opinions have we been stating? 32. What says Dr. Lizars? 33. What observation is made by Professor Hinds? 34. What is said by Professor Bartholow of tobacco as a medicine?

QUESTIONS ON CHAPTER VIII.—PAGE 263.

1. What is the next character tobacco assumes? 2. To whom is this character attractive? 3. What are his name and appearance? 4. What question would you be apt to answer with a smile? 5. Where does the smoke from the cigarette go? 6. What is the effect of blowing the smoke through the nose? 7. Who are the companions of the cigarette? 8. What is the first effect of tobacco? 9. What would be its effect on growing boys? Why? 10. What foolish thought have girls sometimes? 11. How does tobacco treat women? 12. What says Dr. Bartholow? 13. What is said of this habit and its effect? 14. What is its effect on courage? 15. What is the report from Paris? 16. Whom should the boys shun?

Questions on Chapter IX.—Page 266.

1. What is tobacco's most successful character? 2. What attire does he assume? 3. What does he call himself? 4. How has the dandy blinded the eyes of girls and women? 5. What does smoking promote? 6. What is our most important food? 7. Who will poison this food? 8. How does the father treat the child? 9. What says Emerson? 10. Whose children have weakened constitutions? 11. Who suffers for the sins of the tobacco-smoker? 12. How does it affect the children? 13. What says Dr. Elam? 14. What is tobacco under all disguises? 15. In what does he fulfil more than he promises? 16. For what does the user of tobacco spend his money? 17. How much will a smoker spend in a year? 18. How much did the New York merchant save in thirty-nine years? 19. What does Professor Hinds calculate? 20. What will the smoker have as his reward? 21. What do insurance agents say? 22. What illustrations are given? 23. What is tobacco to worthy ambitions?

Questions on Chapter X.—Page 270.

1. What is first said of the condition of the earth and man? 2. What did Abou Ben Hassan find? 3. What did the spirit say? 4 What did he promise to him and his friends? 5. What happened when the spirit was liberated? 6. Of what did Ben Hassan think this a proof? 7. What effect did Gohul's presence have at feasts? 8. How did he become a friend to the sorrowful? 9. How did he seem to affect the intellect? 10. Why was he called the friend of the warrior? 11. Why of the sick? 12. Who employed him? 13. What did he at last begin to call himself? 14. What did he say that he did? 15. What was the effect of increased confidence in Gohul? 16. Who had never been friends with Gohul? 17. What had Observation noticed in regard to children? 18. What in regard to women? 19. What in regard to some men? 20. What did Observation report? 21

What effect did this have upon Gohul? 22. What did he say of Observation? 23. What did he demand? 24. Whom did he want in this committee of investigation? 25. Why would this not be just? 26. What was agreed upon? 27. Of whom was the committee composed? 28. What occurred? 29. What report was first submitted? 30. What was this report? 31. What was the other report? 32. What did she first say? 33. Whom did she employ as an assistant? 34. Whom did she find Gohul to be? 35. Whose offspring is he? 36. What is fermentation? 37. What is wine? 38. How are different wines made and flavored? 39. What increases the strength of wine? 40. What makes wine injurious? 41. Have all wines alcohol in them? 42. How has alcohol deceived man? 43. Has he been a friend to the sick? Why not? 44. What did science call Gohul? 45. What did Gohul say to the report of Science? 46. What question did he ask? 47. How did he answer this question? 48. What became of her report?

QUESTIONS ON CHAPTER XI.—PAGE 279.

1. What picture of peace is here presented? 2. Who saw this, and what did he say? 3. What did he do? 4. What did men do? 5. What did they imagine they had obtained? 6. How did this affect Gohul? 7. What new name did he adopt? 8. Was he an acquaintance of Gohul? 9. What comparison did he make between himself and Gohul? 10. What was now his personal appearance? 11. How did he act? 12. Whom did he love? 13. What said he to men? 14. What was the effect of these fine speeches? 15. What did even wise men say? 16. What strange disease was caused by wine? W17. hat did they think of beer? 18. For what did they think beer a cure? 19. What did Observation notice? 20. What did he do? 21. What did men say? 22. What did they do? 23. Who made up this committee? 24. How did this committee agree? 25. What was the first report? 26. What was said in favor of beer? 27

Who signed this report? 28. What was the other report? 29. What did this branch of the committee find? 30. Whom had they consulted? 31. What did Chemistry explain? 32. Describe the process of beer-making. 33. What is the first step in making beer? What takes place? 34. The second step? What does this do? 35. The third step? 36. The fourth step? 37. What is this process? 38. What takes place? 39. Why are hops added? 40. When is beer barrelled or bottled? 41. What are ale, porter, and stout? 42. What increases the evils of these drinks? 43. What does Chemistry find in beer? 44. What is said of cocculus indicus? What symptoms arise from it? 45. How else is beer sometimes poisoned? 46. How is the habitual beer-drinker known? 47. What else is said of him? 48. How does alcohol affect the nerves which govern the size of capillaries? 49. What do the immense quantities of beer do? 50. What results from these two things? 51. What other result? 52. What does a natural liver weigh? 53. What may a beer-drinker's liver weigh? 54. What is said of beer-drinking nations? 55. Why are their faces ruddy?—ANS. Because of the paralysis of the capillary nerves, and from the excess of water in the blood. 56. What has been done instead of gaining strength? 57. How can you prove that this is waste matter and not strength? 58. What is said by physicians in Europe and America? 59. Why do they dread to perform surgical operations on beer-drinkers? 60. What about abstainers? 61. What is the unqualified testimony? 62. What does one English doctor say? 63. Of 1,540 cases of gout how many were abstainers? 64. What else about him? 65. What does the great German chemist Liebig say? 66. What is finally said of the beer-drinker?

QUESTIONS ON CHAPTER XII.—PAGE 287.

1. What resulted from Gohul's great strength? 2. What effect did this have on men? 3. What desire arose? 4. What was Gohul in his new guise called? 5. What was now believed

of him? 6. Did all believe this? 7. Who were his friends? 8. How did many prove their friendship? 9. What did these organizations do? 10. What came through the influence of Gohul? 11. How did this affect Gohul? 12. What had he done? 13. What had he stolen? 14. What dimmed? What enfeebled? 15. What else had he stolen? What deepened? 16. What had he done to the nose? 17. What had he done to the joints? 18. How had he truly affected the mind? The tongue? 19. How had he affected the mind, heart, and temper? 20. What had he done to the young? The middle-aged? 21. What had he brought to all? 22. Did this open the eyes of all? 23. What was the greatest harm he had done to men? 24. What was his greatest source of power? 25. What did men call him? 26. What had Observation been doing meanwhile? 27. What did he say? 28. What had Gohul stolen? 29. Who denied these assertions? In what words? 30. How did they try to prove that Gohul was not bad? 31. What now occurred? 32. What did Gohul's opponents demand? 33. What answer was made by his friends? 34. What did the people ask? 35. Was their request granted? 36. What did the people say? What is the meaning of "*Vox populi, vox Dei*"?—ANS. The voice of the people is the voice of God. 37. How is the Government formed? 38. What does Chemistry tell us? 39. What is distillation called? Is this true? 40. From what is whisky distilled? 41. From what is rum distilled? 42. From what is brandy distilled? 43. What does Chemistry show? 44. What cry does Science echo? 45. Where and how does he begin his theft? 46. What cry does he set up? 47. Where does he get water? 48. What does he produce in the stomach? 49. Where does he go from the stomach? 50. What does the liver think of him? And what does it do? 51. What effect does this effort have on the liver? 52. What is cirrhosis? 53. What is said of albumen? 54. What effect has alcohol on albumen? 55. What on the red corpuscles of the blood? 56. Where else does alcohol go, and with what effect? 57. How does alcohol affect the heart? 58. How many times does the heart naturally beat in twenty-four hours? 59. How many ounces of blood raised at

each stroke? 60. How many ounces in a day? How many tons is that? 61. To what is the daily work of the heart equal? 62. What surprising statement is made? 63. What does alcohol cause the heart to do? 64. What will be the effect of one fluid ounce a day? 65. Of eight ounces? 66. What is often said of taking two ounces of alcohol daily? 67. In what would one drink two ounces of alcohol? 68. Why is the heart in such a hurry? 69. What does the heart do at every beat? 70. Why does the blood receive a check in the capillaries? 71. What does alcohol do to the capillaries, and how? 72 What is the result? 73. What is the testimony of medicine? 74. What is preferable to alcohol as a tonic? 75. What do physicians acknowledge? 76. Who especially believed these teachings? 77. What did they do? 78. What resulted? 79. What did the rulers ask? 80. What did the people reply?

QUESTIONS ON CHAPTER XIII.—PAGE 294.

1. What does Gohul say? 2. What feeling was aroused by these? 3. What was done? 4. Of whom did the committee consist? 5. Whom did they examine? 6. What per cent. of alcohol in whisky? In brandy? In wine? 7. What per cent. in beer? Are ale and porter stronger than beer? 8. Which of them are harmful? 9. Of what is alcohol a product? 10. Where does it originate? 11. What is needed for its production? 12. What does fermentation do to grains? 13. What are the legitimate uses of alcohol? 14. When is it injurious to man? 15. Who desires other drinks than water? 16. What fluid quenches thirst? 17. What is abnormal? 18. Is alcohol a food? 19. What then is it? 20. What kind of a poison? 21. What is the effect of small doses? 22. How does it work? 23. How long may its evil effects remain unrecognized? 24. What organs are engorged with b' ood by its use? Why? 25. Time effects what changes? 26. What effect does alcohol have on the red corpuscles? 27. What on the membranes of the

lungs? 28. What results from this? 29. What is said of membranes? 30. What are most of these membranes? 31. What effect does alcohol have on these membranes? 32. Upon what does the growth of the body depend? 33. How may dropsy be caused by alcohol? 34. What causes a feeling of warmth? 35. What effect does this have on internal organs? 36. What changes in temperature during intoxication? 37. How long does it take to recover from this loss of heat? 38. When is a chilly feeling experienced? 39. How does alcohol check waste? 40. What does this do to the system? 41. What effect has hardening the membranes? 42. How does this affect the body? 43. What is the peculiarity of vital processes? 44. What comparison is used in regard to checking waste? 45. Why is alcohol not a food? 46. Does it seem to increase digestion? 47. How does it affect the nerves? 48. What is lost? With what result? 49. Why may men under the influence of alcohol be frozen? 50. How does it affect the brain? 51. How many diseases mentioned in the list caused by alcohol? 52. Whom has science questioned? 53. How does alcohol affect man's physical powers? 54. How has the rheumatism of drunkards been cured? 55. What is said of cholera and alcohol? 56. Alcohol and surgical operations? 57. What is said of those who do not use alcohol? 58. What of sunstroke and alcohol? 59. What is said of the water-drinker? 60. Whom next does science question? 61. What do children inherit? What is the meaning of inherit? 62. What effect does alcohol have upon the children of those who use it? 63. What diseases may children inherit from drinking parents? 64. Whom next does science question? What does alcohol? 65. What does the production of alcohol destroy? 66. What kind of a business is it? 67. What amount yearly is spent for alcohol? 68. What effect does this expenditure have upon families? 69. How do drinkers lose time? 70. How does alcohol shorten life? 71. How does alcohol cost the country large sums of money? 72. How many drunkards die every year? 73. What number does alcohol send yearly to prison? 74. How many children to the poorhouse? 75. What causes murders? And suicides? 76.

How many orphans left to charity annually? 77. What amount is spent yearly to support paupers? 78. Whom does science next question? 79. What perverts the moral sense? 80. What destroys conscience? 81. What effect has alcohol on the reason and judgment? 82. What does it cause? 83. What causes shipwreck? 84. How does alcohol affect the gentleman? 85. What is the statement of the grand jury? 86. What is the effect upon those who sell liquor? 87. What upon women and children? Would you like to live where no alcohol is sold? 88. What is said of a city where no alcohol is sold? 89. What is said of using fermented wine at the sacrament? 90. What kind of wine should be used at the sacrament?—ANS. Unfermented. How should we vote on this subject?

QUESTIONS ON CHAPTER XIV.—PAGE 308.

1. What would be the result if company were never entertained in the house? 2. What do we need to keep us in repair? 3. Who is the first guest invited to the house? 4. What come in with milk? 5. Who are the Albuminoids? What do they form? 6. Where are they found? 7. What are they called in the blood? In wheat? In milk? 8. What kind of a food is milk? 9. Of what is solid food made up? 10. Who is the next guest? 11. What proportion of the body is water? 12. What of the bones? The brain? 13. What does this prove? 14. How much water do we need in a day? 15. Where do we get it? 16. What proportion of beef is water? Of turnips? Parsnips? 17. What are fruits? 18. What else do they contain besides water? 19. What work do the acids of fruits do in the system? 20. Why are fruits good company? And for whom? 21. What causes rickets? 22. What say the Germans of phosphorus? 23. What does the Man Wonderful ask? 24. What has he learned? 25. What neighbors has man? What do they do for him? 26. What does he do for them? 27. Who are these neighbors? 28. What do plants do? 29. What are inorganic materials? 30.

What are organic substances? 31. What are plants and animals? 32. How do they differ? 33. What is phosphorus, and where found? 34. For whom are grains good food? 35. Why do grains need long cooking? 36. What foods are not suitable for infants? Why? 37. Why have infants no saliva? 38. Why do rice and tapioca need saliva? 39. What is starch called? 40. What guests are welcomed by children? 41. Where do we find sugar? 42. From what is it made? 43. What foods come next? 44. Where can we obtain fats? 45. How are starch and fat used? 46. What may they be called? 47. What may other substances be called? 48. To what should our food be suited? 49. Should the child or adult eat most meat? 50. Which should eat the larger quantity, the laborer or the lawyer? 51. What is said of the farmer's boy who becomes a student? 52. What question deserves our attention? 53. What rewards a wise choice?

INDEX.

"SHOULD BE IN THE HANDS OF EVERY BOY AND GIRL."

"Moliere's plays endured the test of the criticism of his servant. The chapters of this work of the Doctors Allen have riveted the attention of a little girl of intelligence only seven years of age. Anatomy and physiology made attractive to a child must be interesting to any man or woman. I find a great deal of science, of felicitous analogy, and graceful expression in these terse and instructive chapters. The scientific training and experience, at home and abroad, of the authors, husband and wife, give me confidence in the technical accuracy; the agreeable style charms my attention, and will, I think, delay any one who will take the book up. I think for public instruction it would make a most popular handbook.

"CHARLES M. TYLER, Pastor of the First Cong. Church, Ithaca, N. Y."

"I am especially obliged to you for the book, so novel in its character, so interesting, and so instructive. I do not see how it can be otherwise than a great success.

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"Your book is full of interest and information of high value to all. I hope your book will do something towards dispelling the prevailing ignorance on these subjects

"**Hon. T. M. COOLEY, LL.D., Ann Arbor, Mich.**"

"I can say in a word, that the favorable impression which I had formed from reading a portion of the book in the *Christian Union*, has been confirmed by an examination of the book itself.

"LYMAN ABBOTT, LL.D., Editor of the *Christian Union*."

"I have examined the book with interest and admiration, for the easy, simple manner in which the information is conveyed. The allegory is an attractive form of writing. It seems easy, and many young writers are allured into ridiculous inconsistencies by adopting it; but the Allens have been singularly happy in both the conception and the execution of this volume, and we do not know another book so likely to be of help to young teachers in carrying out the temperance law. This volume fills a real want.

"**C. W. BARDEEN, Editor of the *School Bulletin*.**"

"This book is quite out of the ordinary line of works of this kind. The old and the young will be delighted with it from beginning to end. It is physiology, anatomy, and hygiene served up as a fairy story, only it is truth and not fiction. The latest and best authorities have been consulted, and scientific accuracy attained. The authors should be congratulated on their success in producing so good a work." —***The Herald of Health.***

"Having just given a careful reading to 'The Man Wonderful in the House Beautiful,' by the Drs. Allen, I can not refrain from expressing my commendation of this new book on the anatomy and physiology of the human system. It is so interesting, clear, and accurate, that it would be difficult to overstate its value in the education of the young at home or in school. The authors are evidently acquainted with the latest researches on the subjects of which they treat, and we are amazed by the genius which has brought the finest and most difficult points in anatomy and physiology within the comprehension of young readers. Although written in an allegorical form, no scientific truth has been modified or omitted to meet the requirements of this style. The laws of health are impressed upon the reader by the clear demonstrations of the functions of the different parts of the body, and the delicate mechanism by which they are performed. Aside from the value of the facts stated in the book, the charming style is, in itself, educational. The allegory of king alcohol should be in the hands of every boy and girl, because of its literary beauty and the clearness and accuracy with which the physical, moral, and social effects of stimulants and narcotics are shown.

"**E. W. EDWARDS, M.D., Newark, N. J.**"

"I am favorably impressed with its merits for school use.

"B. B. SNOW, Supt. of Public Schools, Auburn, N. Y."

"'The Man Wonderful in the House Beautiful,' by the Drs. Allen, represents the human body to be the house beautiful, with its doors, windows, rooms, furniture, etc., and the mind to be the man wonderful. They have admirably succeeded in weaving into the several chapters the important facts of physiology and hygiene in such a skillful manner as to make very pleasant reading, and to arouse and hold the interest of the reader, while at the same time, the facts of the subject are ren

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